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DRAFT REPORT

Middletown Airfield Site

Middletown, Pennsylvania

Focused Feasibility Study
Volume I - Report

Under Contract with
U.S. Army Corps of Engineers
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ACRONYMS AND ABBREVIATIONS

ARARs	Applicable or Relevant Appropriate Requirements
AWQC	Ambient Water Quality Criteria
BCFs	Bioconcentration factors
bgs	below ground surface
BR	Bouwer and Rice
BRA	Base-line Risk Assessment
BTAC	Region III Biological Technical Assistance Group
BTE	Benzene,Tolune, Ethylbenzene, Xylene
CDAP	Chemical Data Acquistion Plan
C	Civil Engineering
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	Chain-of-Custody
CP	Cooper Papadopulos
CPFs	Carcinogenic Potency Factors
DCE	1,1′-dichloro-2,2-bis(p-chlorophenyl)ethane
DDE	dichlorodiphenyldichloroethylene
DDT	dichlorodiphenyltrichloroethane
DEHP	bis(2ethylhexyl)phthalate
DI	deionized
DMRs	Discharge Monitoring Reports
DQCRs	Daily Quality Control Reports
ERM	ERM Program Management Company
ESD	Explanation of Significant Differences

FFS	Focused Feasibility Study
FSP	Field Sampling Plan
ft/day	foot per day
ft/ft	foot per foot
GAC	Granular Activated Carbon
Gc/ms	Gas chromatography/Mass Spectrum
GMF	Granular Media Filtration
gpm	gallons per minute
HIA	Harrisburg International Airport
HSA	hollow-stem auger
HSWA	Hazardous and Solid Waste Amendments
ID	inside diameter
IDW	Investigation Derived Wastes
IMS	IMS Environmental, Inc.
IRIS	Integrated Risk Information System
IRP	Installation Restoration Program
IRPIMS	Installation Restoration Program Information Management System
K	Hydraulic Conductivity
LAFB	Langley Air Force Base
LDRs	Land Disposal Restrictions
LLI	Lancaster Laboratories, Inc.
MCLGs	Maximum Contaminant Level Goals
MCLs	Maximum Contaminant Levels
MDA	Minimum Detectable Activity
mg/kg	milligram per kilogram

mg/1	milligrams per liter
MRDL	Missouri River Division Laboratory
msl	mean sea level
NCP	National Contingency Plan
NEPA	National Environmental Policy Act
NPDWS	National Primary Drinking Water Standards
NPL	National Priority List
O&M	Operation and Maintenance
OU	Operable Unit
^{o}C	degrees Centigrade
^{o}F	degrees Fahrenheit
PADEP	Pennsylvania Department of Environmental Protection
PAANG	Pennsylvania Air National Guard
PAHs	Polycyclic Aromatic Hydrocarbons
PADOT	Pennsylvania Department of Transportation
PCBs	Polychlorinated Biphenyls
PID	Photoionization Detector
POL	Petroleum, oils, and lubricants
PPE	Personal Protective Equipment
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
QCSR	Quality Control Summary Report
RBCs	Risk-Based Concentrations
RfDs	Reference Doses

RI	Remedial Investigation
ROD	Record of Decision
S	Storativity
SARA	Superfund Amendments and Reauthorization Act
SCS	Soil Conservation Service
SDWA	Safe Drinking Water Act
SMCLs	Secondary Maximum Contaminant Levels
SSI	Supplemental Studies Investigation
SVE	Soil Vapor Extraction
SVOCs	Semi-Volatile Organic Compounds
T	Transmissivity
TAC	Tactical Air Command
TAL	Target Analyte List
TBC	To be Considered
TCE	trichloroethylene
TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
TDS	Total Dissolved Solids
TICs	Tentatively Identified Compounds
TPH	Total Petroleum Hydrocarbons
TRs	traffic reports
TSCA	Toxic Substances Control Act
TSD	Treatment, Storage, or Disposal
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
UST	Underground Storage Tank

EXECUTIVE SUMMARY

INTRODUCTION

The United States Army Corps of Engineers (USACE), Omaha District has tasked ERM Program Management Company (ERM) to conduct a Supplemental Studies Investigation (SSI) at the Middletown Airfield NPL Site (Site), Middletown, Pennsylvania and prepare a Focused Feasibility Study (FFS) report based on the data collected during the SSI. This FFS summarizes current conditions at the Site and includes a discussion of the work completed and results obtained from the SSI performed at the Site. The report also presents the results of a baseline risk assessment (BRA) and evaluates the need for remedial action based on all the data collected during the SSI was well as data from a parallel study undertaken by Penn Dot.

Site Description

The Site is located in Dauphin County, Pennsylvania, about 8 miles southeast of Harrisburg. It is situated between the boroughs of Highspire and Middletown along Pennsylvania Route 230, and bordered by the Susquehanna River to the south.

The property was initially established by the Army as a basic training camp in 1898. After various transitions and reassignments, the site was renamed Olmsted Air Force Base in September 1947. Activities throughout the history of the Site included:

- warehousing and supply of parts, equipment, general supplies, petroleum, oil and lubricants (POL) for the Northeast Procurement District;
- complete aircraft overhaul including stripping, repainting, engine overhaul, re-assembly, and equipment replacement;
- engine and aircraft testing; and
- general base support maintenance and operation.

The Air Force field and most of the Air Force buildings are currently owned by the Pennsylvania Department of Transportation (Penn DOT) Bureau of Aviation which maintains and manages the Harrisburg International Airport (HIA).

Studies have been conducted at the facility since 1983 to investigate and monitor areas that been affected by operations at the Site. In March 1983, the volatile organic compound (VOC) trichloroethylene (TCE) was discovered in six of ten HIA production wells which triggered subsequent environmental investigations and studies, and the installation of a water treatment system that is currently still in use at the facility. The Site was later listed on the United States Environmental Protection Agency's (USEPA) National Priorities List (NPL) of hazardous waste sites. The Site was listed because of the contamination of ground water by TCE.

Scope and Role of Operable Unit

A ROD was issued for the Site for the protection of the drinking water supply in the area in December 1987. This ROD outlined an interim remedy which focused on the drinking water supply as an operable unit. The ROD remedy consisted of providing a potable water supply to those served by the HIA water system. A central air stripping tower and treatment plant was constructed for this purpose.

A second ROD was issued for the Site in 1990. Subsequently, five major study areas, operable units (OU), have been designated for the site.

- OU-1 Industrial Area - HIA Ground Water Production Wells
- OU-2 Industrial Area - Soils
- OU-3 Fire Training Area - Soils
- OU-4 North Base Landfill Area - Ground Water
- OU-5 Meade Heights Area - Surface Water

The 1990 ROD addressed OUs 1, 2, 3, and 4 and an interim action at OU-5, since the field investigation results were inconclusive in determining a source of contaminants and their potential environmental impact.

Under the 1990 ROD, the remedy selection for OU-1 was the continued operation of the ground water treatment system currently in place at the Site, the institution of ground water use restrictions, and the addition of monitoring for the water supply wells.

The remedy for OU-2 and OU-3 included land use and access restrictions, and the development of public and worker health and safety requirements for activities involving construction, demolition, and excavation or other activities that would disturb the Site soil.

The remedy for OU-4, which provides protection of well MID 04, from contaminants found in the North Base Landfill, was to include it with the remedy for OU-1 to efficiently and effectively address ground water contamination at the Site.

The interim action required for OU-5 included the evaluation of water quality and organisms living in the stream near Meade Heights.

The SSI discussed in this report was required by the USEPA's December 1990 ROD, as clarified by the April 1992 Explanation of Significant Differences (ESD). After reviewing the ROD, the Pennsylvania Department of Environmental Protection (PADEP) asserted that the ROD did not fully investigate the relationship between soil and ground water contamination, nor did it consider active soil cleanup technologies. The USEPA incorporated the PADEP concerns into an ESD document. The ESD explained that the ground water remedy selected in the ROD was an interim action and that the final decision would follow in the ROD issued after the SSI was complete. The ESD further clarified that the requirement in the 1990 ROD that the existing water supply system must continue to operate even if airport operations cease was eliminated and would be re-evaluated at a later date. The intent of the SSI was to satisfy the requirements of the ESD and the 1990 ROD.

Summary of Site Risks

A BRA was completed and the results generated were integrated with information regarding site use and site activities in order to derive appropriate remedial action objectives. The BRA focused on three distinct areas of concern; soil, ground water, and surface water/sediment. Each of these areas were further divided for analysis purposes.

The soils of the Industrial Area, Meade Heights, the Penn State Area, and the Warehouse Area were evaluated individually. Cumulative risks for workers and residential exposures were estimated using the default risk based concentrations (RBCs) developed by the USEPA Region III. In addition, the BRA also evaluated the potential for soils to pose a threat to ecological receptors. Based on the results of the BRA and current and anticipated future site use scenarios, no actions are necessary to address soils at the site.

Ground water in the Industrial Area, the North Base Landfill Area, and residential wells was evaluated in the BRA. The primary constituent of concern in ground water in the Industrial Area is TCE. However, as previously discussed, remedial efforts are currently in place at the Site to manage TCE contamination in ground water in the Industrial Area. Ground water in other areas were found to contain low levels of a few contaminants; however, none were determined to be a concern or a potential future threat because of a lack of exposure potential.

Surface water and sediment samples were collected from the Susquehanna River and from the Meade Heights stream. Human exposure to the contaminants detected in the surface water and sediments in the Susquehanna River was shown to be limited because of the restricted access to the shoreline. In the Meade Heights Area, the only contaminants detected of concern were inorganics. A comparison of upgradient and downgradient samples indicated that the concentrations detected were likely naturally occurring. This coupled with the facts that the most likely exposure to the constituents would be from children playing in the stream, and that the inorganics are poorly absorbed across the skin; shows that no unacceptable risk are expected to be associated with these constituents. Ecological receptors are not expected to be impacted by the constituents found in the surface water or sediments.

Subsequently, the remedial action objectives reached based on the BRA are presented below.

- No action is necessary to address soils at the Site.
- Institutional restrictions on ground water use should be (and are being) continued in the Industrial Area and south of the North Base Landfill.
- It is expected that pumping and treating ground water in the Industrial Area will continue to control the discharge of ground water to the Susquehanna River as required in the 1990 ROD.
- On-going monitoring of surface water and sediment in the Susquehanna River is required as part of the 1990 ROD. No other actions are deemed necessary at this time.
- On-going monitoring of the sentinel wells at the North Base Landfill Area is required as part of the 1990 ROD as protection for well MID-04. No other actions are deemed necessary at this time.
- No action is required for surface water or sediment in Meade Heights.
- In the event that the HIA should cease the pumping of the production wells, there shall be a 5 year sampling and review period to assess whether any impact is being felt in the Susquehanna River.

- In the event any additional new or existing wells are to become operational in the HIA Industrial Area, the extracted ground water should be tested initially and monitored at least annually to document that there is no impact is being felt from the migration of contamination under the new pumping scenario at the Site.

Based on the results of the SSI and BRA, no additional action is required at the Site.

Elevated levels of organic and inorganic constituents were detected in Vault J-5 of the storm sewer system (approximately 100 feet west of the southwestern corner of Building 208) during the SSI. The USACE is currently seeking a contractor to clean Vault J-5 to remove the storm sewer sediment. The remainder of the storm sewer system will be addressed during the on-going storm sewer discharge permitting process. The storm water permit is expected to be in effect by the end of July 1996 (Personal Communication, 1996).

Description of the "No Action" Preferred Alternative

Under CERCLA, USEPA can determine that the need to undertake a remedial action to ensure adequate protection of human health and the environment under Section 104 or 106 is not necessary and need not be invoked. Under such circumstances, the statutory cleanup standards of CERCLA Section 121 (e.g., compliance with Applicable, or Relevant and Appropriate Requirements [ARARs] and cost-effectiveness) are not triggered and need not be addressed in documenting the determination that a "No Action" decision is appropriate for the Site.

While "No Action" decisions may authorize monitoring to verify that no unacceptable exposures occur, such response decisions should not include any additional measures to eliminate, reduce, or control threats beyond the mitigation measures previously implemented. Therefore, a remedy including any treatment controls, engineering controls, or institutional controls would not be considered a "No Action" remedy.

Based on the results of the BRA conducted as part of this SSI, it is concluded that the conditions at the site pose no current or potential threat to human health or the environment and no further remedial action need be implemented. Consequently, the site qualifies for a "No Action" decision.

Although potentially hazardous constituents are present in site ground water, measures are already being taken to remedy that condition. The ongoing nature of that remedial action has been taken into account in the selection of the "No Action" decision.

The results of this FS will be used to prepare a Proposed Plan that will outline the selection of a final remedy for the site. The Proposed Plan will be issued as part of the public participation responsibilities under Section 117(1) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), commonly referred to as "Superfund", as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) and, to the extent possible, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP, 40 CFR 300).

The public is encouraged to become involved in the selection of the remedy by participating in the public meeting and public comment period. For more background on the site and environmental activities previously and currently being conducted, the public is invited to review this and other documents in the Administrative Record. The Administrative Record, which contains all information that will be used to select the response action, is available for public review at the following locations:

Middletown Public Library
20 North Catherine Street
Middletown, PA 17057

and

Administrative Record Coordinator
U.S. Environmental Protection Agency, Region III
841 Chestnut Street
Philadelphia, PA 19107

USEPA solicits input from the community on the cleanup methods proposed for each Superfund response action proposed. A public comment period will be announced after printing of the Proposed Plan. The community is encouraged to participate in the selection process. A public meeting will also be held at which time USEPA, along with the State Department of Environmental Protection and Department of Defense (DoD) representatives will present the Proposed Plan, answer questions, and accept oral and written comments.

Comments will be summarized and responses provided in the Responsive Summary section of the ROD. The ROD is the document that presents the final remedy selection for the site.

1.0 INTRODUCTION

The United States Army Corps of Engineers (USACE), Omaha District has tasked ERM Program Management Company (ERM) to conduct a Supplemental Studies Investigation (SSI) at the Middletown Airfield Site (Site), Middletown, Pennsylvania and prepare a Focused Feasibility Study (FFS) Report based on the data collected during the SSI. The purpose of the FFS is to identify, evaluate, and quantify potential remedial alternatives associated with the remediation of contaminated media at the Site. These studies were required by the United States Environmental Protection Agency's (USEPA) December 1990 Record of Decision (ROD), as clarified by the April 1992 Explanation of Significant Differences (ESD). This work was conducted under Contract Number DACW-45-93-0017, with the USACE Omaha District, Delivery Order Numbers 005, 006, 008 and 009.

In March 1983, the volatile organic compound (VOC) trichloroethylene (TCE) was discovered in six of the ten Harrisburg International Airport (HIA) production wells (HIA-1 through -5 and -13), triggering subsequent environmental investigations and studies, and the installation of a water treatment system that is currently still in use at the facility. The Site was later listed on USEPA's National Priorities List (NPL) of hazardous waste sites. The NPL is a list of those uncontrolled or abandoned hazardous waste sites which, in the opinion of the USEPA and based on available data, present the greatest risk to human health and/or the environment. The Site was initially listed because of contamination of ground water by TCE.

The remedy selected in the 1990 ROD involved continued operation of the existing drinking water supply treatment system and the current distribution system, the institution of ground water use restrictions, and additional monitoring of the water supply wells. The 1990 ROD also identified the use of institutional controls to restrict access and address direct contact and other threats from contaminated soils that may be exposed at the site during construction, demolition, excavation or other activities that disturb site soils. Finally, installation of sentinel wells between the North Base Landfill and Middletown production well MID-04 and quarterly monitoring of the newly installed wells was required along with restrictions on permitting of new wells downgradient of the North Base Landfill Area.

After reviewing the ROD, the Pennsylvania Department of Environmental Protection (PADEP) asserted that the ROD did not fully investigate the relationship between soil and ground water contamination, nor did it consider active soil cleanup technologies. The USEPA incorporated PADEP concerns into an ESD document which required additional studies to address PADEP concerns. The ESD explained that the ground water remedy in the 1990 ROD was an interim action and that the final decision would follow in the ROD issued after the SSI. The ESD further clarified that the requirement in the 1990 ROD, that the existing water supply system must continue to operate even if airport operation ceases, was eliminated and would be re-evaluated at a later date. The SSI was intended to satisfy the requirements of the ESD and ROD.

This FFS was prepared in accordance with USEPA's "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA" (USEPA, 1988) and guidance documents associated with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) and "Guidance on Feasibility Studies Under CERCLA" (USEPA, 1985). The procedures used in this study were consistent with the National Contingency Plan (NCP) and the Department of the Army's policy toward integrating the National Environmental Policy Act (NEPA) and CERCLA/SARA processes.

1.1 FOCUSED FEASIBILITY STUDY OBJECTIVES

The SSI performed at the Site was completed in an effort to identify if any previously undetected contamination remained and to determine if such contamination could present an unacceptable risk to human health and the environment. The objectives of this FFS were:

- to evaluate the results of the SSI and risk assessment to determine what, if any, areas of the site should be considered for remedial action,
- to identify remedial action objectives (as necessary) associated with any potential remediation of contaminants, and
- to present and evaluate remedial alternatives (as necessary) to develop a rationale for a remedy selection at the site.

1.2 *REPORT ORGANIZATION*

The remainder of the report is organized into the following sections, along with supporting appendices documenting various components of the study.

1.2.1 *Section 2 - Background/Site History*

This section presents information on the physical and environmental setting; operational history of the Site; soil, ground water, and surface water characteristics throughout the Site; and previous investigations and remedial actions completed to date.

1.2.2 *Section 3 - Baseline Risk Assessment*

The baseline risk assessment (BRA) presents an evaluation of potential risks associated with the Site based on soil, ground water, sediment, and surface water data collected during the SSI. Results of the BRA will be used, together with other risk management criteria, to define remedial action objectives for the FFS.

1.2.3 *Section 4 - Risk Management Analysis*

This section presents the risk management analysis for the Site. In developing this analysis, results of the BRA are integrated with information regarding Site uses and activities to define appropriate remedial action objectives for the FFS. These remedial action objectives are then used to focus the development of remedial alternatives, if necessary.

1.2.4 *Section 5 - Presentation of "No Action" Alternative*

This section presents the basis for supporting a "No Action" alternative. The discussion focuses on the determination that no action is needed for the protection of human health and the environment based on the on-going remedial efforts at the Site, the information and data collected during the SSI, and the assessment of potential risk performed in the BRA.

1.2.5 *Appendices*

The appendices of the FFS Report contain information collected as part of performing the SSI. A listing of the appendices is as follows:

A HTW Drilling Logs and Well Construction Information
B Borehole Geophysical Logs
C Map Plates
D Site Investigation Methods
E Analytical Data
F Risk Assessment Screening Output
G Meade Heights Stream Survey
H Monitoring Well Development Forms
I Monitoring Well Data Sampling Forms
J Slug Test Data
K Capture Zone Tests and Analysis
L Ground Water Flow Modeling

A detailed description of the various tasks and field methods along with figures showing the sampling locations are provided in Appendix D. Therefore, references to Appendices G through L, which contain work products resulting from tasks described in Appendix D, are mentioned first in Appendix D. This organization is out of the ordinary, but in keeping with the overall organization of a FFS report.

2.0 BACKGROUND/SITE HISTORY

Information presented in the following sections has been summarized primarily from the Final Remedial Investigation Report dated July 1990 (Gannett Fleming, 1990b) and the Final Feasibility Study Report dated August 1990 (Gannett Fleming, 1990a). Additional detail resulting from the SSI performed by ERM has been incorporated into the discussions of site geology, hydrogeology and ecology.

2.1 SITE DESCRIPTION

The Middletown Airfield Site is located in Dauphin County, Pennsylvania, about 8 miles southeast of Harrisburg. It is situated between the Boroughs of Highspire and Middletown (Figure 2-1 and Figure 2-2) along Pennsylvania Route 230, and bordered by the Susquehanna River to the south.

The Site lies within the Triassic Lowland of the Piedmont Physiographic Province. The Triassic Lowland is characterized by gently undulating topography, which slopes generally to the south and is traversed by long low ridges and a few round hills. Elevations on the Site range from 280 feet above mean sea level (MSL) at the Susquehanna River to approximately 420 feet MSL at the northern boundary.

Portions of the Site are located on the flood plain of the Susquehanna River. However, the majority of this area has been developed into the HIA and an industrial area. Very little of the area is an undisturbed natural area because of the industrial/commercial land uses. No federal or state threatened or endangered species are located in the vicinity. Adjacent properties include commercial/industrial and residential land uses.

Approximately 14,320 people reside in the Boroughs of Highspire, Middletown and Royalton, according to 1986 Bureau of Census data. The 1990 population was estimated to be 14,811, based on a linear projection of data for 1980, 1983, and 1986.

Potentially sensitive populations located within 1 mile of the Site boundaries include the Odd Fellows Home, schools in the Borough of

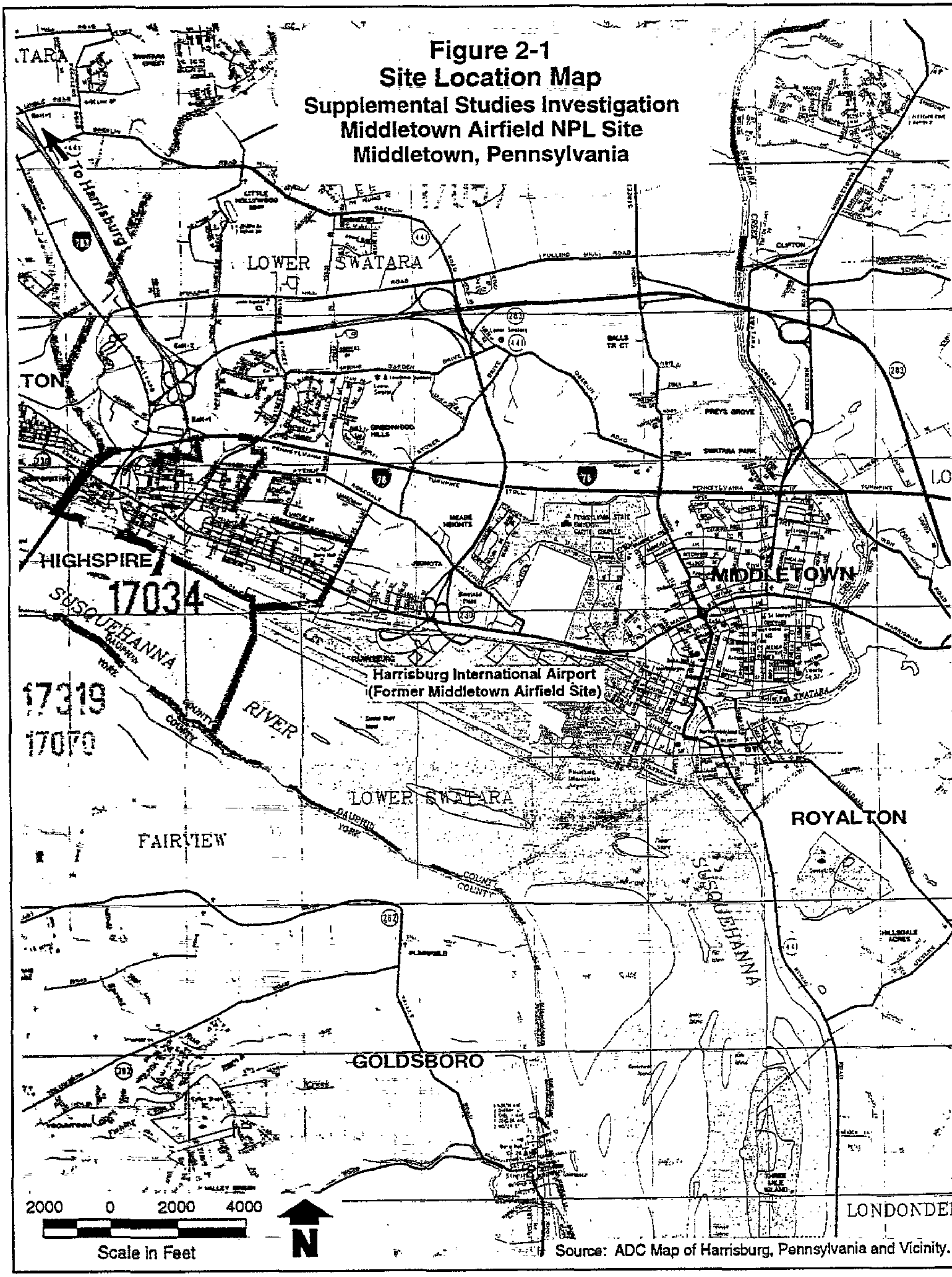
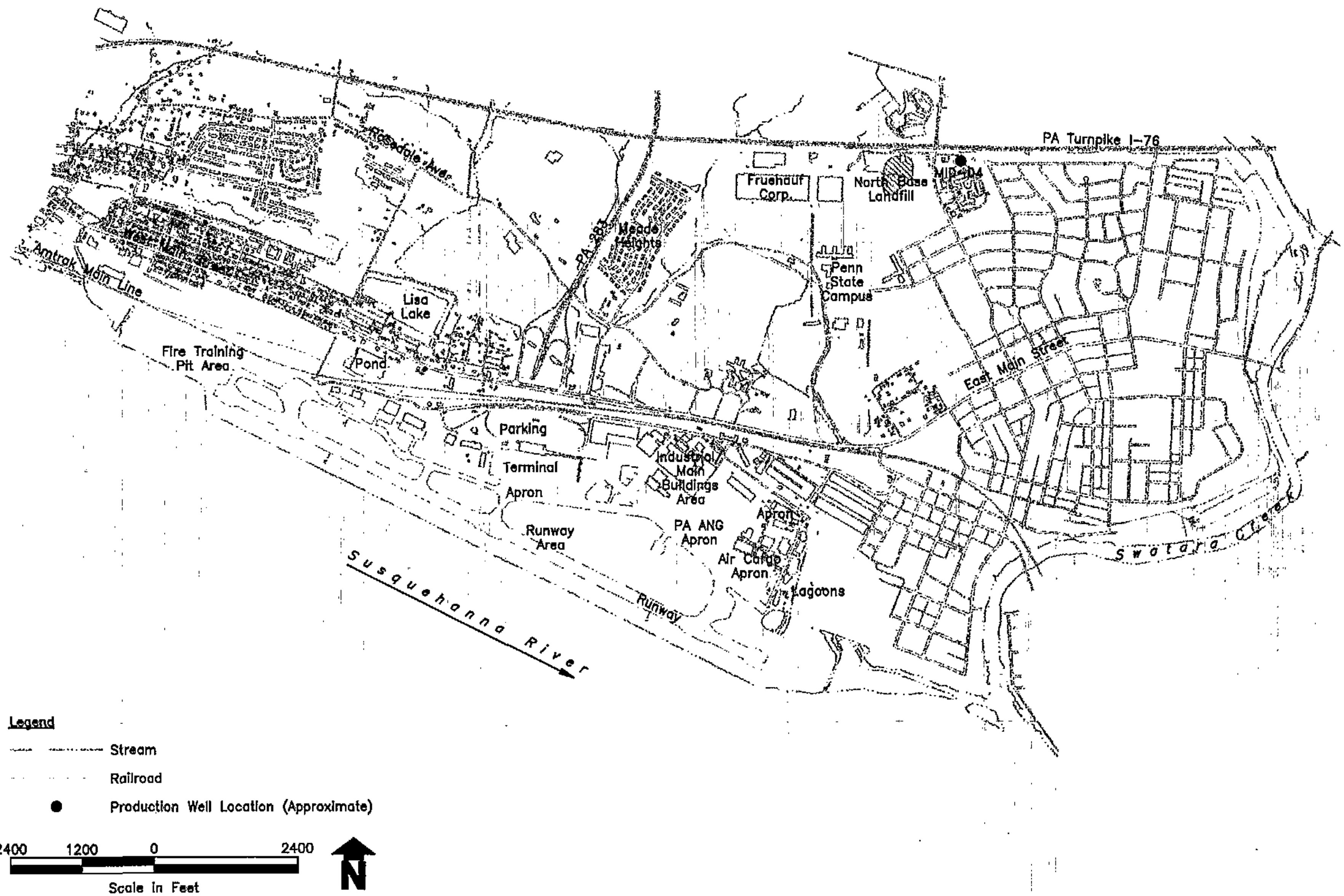


Figure 2-1
Site Location Map
Supplemental Studies Investigation
Middletown Airfield NPL Site
Middletown, Pennsylvania
To Harrisburg
LOWER SWATARA
HIGHSPIRE
17034
SUSQUEHANNA
RIVER
17319
MIDDLETOWN
Harrisburg International Airport
(Former Middletown Airfield Site)
ROYALTON
LOWER SWATARA
FAIRVIEW
SUSQUEHANNA
GOLDSBORO
LONDONDER
2000 0 2000 4000
Scale in Feet
N
Source: ADC Map of Harrisburg, Pennsylvania and Vicinity.

Figure 2-2
Generalized Base Map
Middletown Airfield NPL Site
Middletown, Pennsylvania



Middletown, the Pennsylvania State University Capitol Campus, and HIA employees, tenants, and passengers.

No federal or state parks are located within 5 miles of the Site, and there are no national wildlife refuges, Audubon refuges or Pennsylvania Game Commission state gamelands within 5 miles of the Site. Neither the Susquehanna River nor the Swatara Creek are listed as a wild and scenic river.

2.2 *SITE HISTORY*

The HIA property was initially established by the Army as a basic training camp in 1898. In May 1917, the Army Signal Corps established a storage depot on 47 acres of this area, which was known as the Aviation General Depot. Flying activities and construction of warehouses, open sheds, and garages for storage began in 1918 . The depot was renamed Middletown Air Intermediate Depot in 1921. The airfield was named the Olmsted Field for Lt. Robert S. Olmsted in 1923.

From 1931 to 1939, the Middletown Air Intermediate Depot operations remained stable, and the main functions were supply and maintenance of Army Air Corps materiel. During World War II, facilities were expanded. In 1943, the facility was assigned to the Middletown Air Depot Control Area Command. The Command was redesignated the Middletown Air Technical Service Command in 1944 and was changed again in 1946 to Middletown Air Materiel Area. Activities during World War II included the overhaul of P-40, P-38, and B-25 type aircraft. In September 1947, Olmsted Field was renamed Olmsted Air Force Base to coincide with the designation of the Air Force as a separate Department of Defense establishment. Activities at Olmsted throughout its history included:

- warehousing and supply of parts, equipment, general supplies, petroleum, oil and lubricants for the Northeast Procurement District;
- complete aircraft overhaul including stripping, repainting, engine overhaul, re-assembly, and equipment replacement;
- engine and aircraft testing; and
- general base support maintenance and operation.

In 1948, four engine test cells were converted for the overhaul of jet engines, marking the introduction of jet aircraft to the base. In 1956, a major expansion of the existing runways to handle jet aircraft was undertaken. Additional property was purchased in 1956 to accommodate facility expansion including property for military housing (Meade Heights), property west of the facility for runway expansion, and property north of Pennsylvania Route 230 for additional bulk warehousing (North Base).

By the early 1960s, Air Force operations at Olmsted began to decrease. The industrial portion of the installation was declared excess to the Air Force in November 1964, and all Air Force operations were ceased by 1966. The Air Force field and most of the Air Force buildings are now owned by the Pennsylvania Department of Transportation (PA DOT) Bureau of Aviation which maintains and manages the HIA. Several small private manufacturing companies are tenants of HIA including the Pennsylvania Air National Guard (PAANG) which owns and operates facilities on the east end of HIA.

For the purposes of this document, the former Olmsted Air Force Base, now the HIA, is referred to as the Middletown Airfield Site ("Site").

2.3 *ENVIRONMENTAL SETTING*

2.3.1 *Soils*

Fourteen soil units have been mapped at the Site by the U.S. Department of Agriculture (USDA) Soil Conservation Service (SCS) (USDA SCS, 1972). More than 75 percent of the soils on Site have been classified as urban land by the SCS. The SCS considers urban land to be soils whose original soil profile has been destroyed or covered by earth-moving equipment. Blast-furnace slag was used for fill when the runway was extended during the period from 1958 to 1961 and covers a large portion of the main airfield area. Blast furnace slag was also observed on the surface of the truck parking area on the south and west sides of the North Base Landfill. Soil borings completed at HIA reveal a deep subsoil composed of a mixture of alluvial terrace and flood plain deposits. Although no attempts have been made to estimate the physical properties of urban land, it is reasonable to assume that they impose the same constraints on construction as the surrounding natural soils; that is, the occurrence of a high water table and periodic flooding.

The majority of the soils north of the Site are designated by the SCS as prime farmland soils of Pennsylvania (Gannett Fleming, 1990b). The only prime farmland soils present on the Site are located in the Meade Heights

Area. None of the prime farmland soils on or in the vicinity of the Site are currently being farmed.

2.3.2 *Geologic Setting*

The Site and the surrounding area are underlain by a complex sequence of interbedded sedimentary rocks known as the Gettysburg Formation of the Triassic age Newark Group. The Gettysburg Formation consists of interbedded red shale; red, brown and gray sandstone; and coarse quartz conglomerate and limestone conglomerate (Wood, 1980). In Dauphin County, the bedrock contains proportionately more shale than sandstone and conglomerate. Near its type locality, in Gettysburg Pennsylvania, the Gettysburg Formation is estimated to be over 15,000 feet thick.

Wood (1980) has mapped the Site and its vicinity as predominantly underlain by Gettysburg Formation shales described as "red and maroon, micaceous and silty mudstones and shales, locally calcareous and some thin red siltstone to very fine grained sandstone interbeds." To the northeast of the site, in the Meade Heights area and beyond, the Gettysburg Formation consists primarily of sandstone units. These sandstone units are described by Wood (1980) as "fine to coarse-grained, red, brown and gray sandstone containing pebbles and some cobbles of well-rounded pink to light-gray vein quartz and quartzite and some clasts of red and brown siltstone and sandstone."

The structure of the rocks in the Newark Group is a north-northwestward dipping homocline (i.e., beds uniformly dipping in one direction) that is modified by local folds plunging northward and reversed dips adjacent to the north border of the basin (where high angle faults form the northern boundary). It is also cut by a few faults at large angles to the strike of bedding. The dip of bedding throughout most of the area is north to northwestward, ranging commonly from 20° to 40° (Wood, 1980).

The following discussion has been summarized from the RI Report (Gannett Fleming, 1990b). Aerial photographs reveal the strike of bedding in the Gettysburg Formation at the airfield and in the streambeds of Swatara Creek and the Susquehanna River (GF, 1990b, after Wood, 1980). It has been reported that the strike of the beds ranges from N5°E to N65°E, with an average strike of N43°E. The dip of bedding is to the northwest at angles ranging from 19° to 38°. The average of nine dip measurements taken by previous investigators near the Fruehauf Corporation facility in the North Base Area was approximately 26°NW (GF, 1990b, after Meisler and Longwill, 1961). Faults have not been mapped in the Gettysburg

Formation in the immediate vicinity of the Site; this unit may be extensively fractured and jointed locally.

Throughout most of the Site, the Gettysburg Formation is covered by alluvial terrace deposits of Quaternary Age. These deposits occur at three levels, marking the three glacial events of the Illinoisan to late Wisconsin ages. The terrace deposits contain "pebbles and cobbles of granite and other igneous rocks, metamorphic rocks, various quartzites, cherts, and boulders of 5 to 10 feet in dimension." The lowest terrace deposit, upon which the main portion of the airfield is situated, occurs at approximately 300 feet MSL and consists of gravel and sand approximately 30 feet thick. The alluvium of higher terraces, which occur at approximately 340 to 380 feet MSL, is described as consisting of thin, discontinuous deposits as much as 20 feet thick. However, in the general area, they may be less than 10 feet thick. The upper portion of the underlying Gettysburg Formation has been described as deeply weathered and broken to a depth of approximately 10 feet prior to the deposition of the gravel. Consequently, cracks between blocks in the uppermost portion of the Gettysburg Formation are filled with alluvial material.

2.3.3 *Site Geology*

The following summarizes previous findings from the RI Report (Gannett Fleming, 1990b) with regard to site-specific geology.

The Runway Area is underlain by unconsolidated deposits ranging from mixed sands and gravels, sands and gravels, fine-grained sediments, and slag-dominated fill materials, with maximum total thicknesses up to nearly 30 feet. Slag, ash, and trash fill materials were particularly common at the river side of the main runway. The bedrock beneath the unconsolidated materials consists of red-brown shale, fine-grained sandstone and siltstone. Coarse-grained conglomeritic zones were also encountered.

Unconsolidated deposits at the Industrial Area ranged from over 10 feet to 28.6 feet in thickness. Three units were recognized: an upper surficial soil, anthropogenic fill, a mixed sands/gravels/silts/clays unit; a middle unit consisting of sandy silty coarse gravels; and a lower unit made up of silty sands from weathered bedrock.

The RI at the North Base Landfill encountered unconsolidated overburden deposits from zero to approximately 20 feet thick overlying a very irregular bedrock surface. These observations confirmed the historical reports of extensive excavation and filling activities in this area. Trash fill, including construction rubble, insulation materials, and paper, was commonly found. Other types of fill included red-brown silty sands, gravel, slag, sandstone, clayey silt and wood. Bedrock at this location was described as moderately weathered, and consisting primarily of red-brown fine to medium grained sandstone with interbeds of conglomerate, siltstone and shale.

Lithologic information from the previous RI work at the Meade Heights area is limited to observations from a single overburden boring. The fill materials encountered were described as man-made components mixed with naturally occurring residuum, extending to 8 feet below ground surface. The bedrock surface at this location is sufficiently weathered to allow auger penetration to approximately 5 feet below the bedrock-soil interface.

Lithologic data collected during the SSI is contained in the soil boring and well drilling logs located in Appendix A of this report. Observations of overburden thickness and composition observed in the Industrial Area and the North Base Landfill area during the SSI drilling activities are consistent with previous RI findings.

Bedrock lithologies observed during the SSI well drilling were described as predominantly red-brown interbedded siltstones and sandy siltstones, with sandstones, silty sandstones and occasional coarse sandstones/conglomerate interbeds. Borehole geophysical logs from the monitoring wells and productions wells surveyed during the SSI are provided in Appendix B. A structural contour map of the bedrock surface elevation (Plate 1, Appendix C) was compiled based on drilling information from previously and newly installed monitoring wells. The bedrock surface beneath the North Base Landfill area slopes at a rate of approximately 80 feet per mile southwestward. In the Industrial Area, the bedrock surface is nearly flat-lying, with an approximate slope of 21 ft per mile toward the Susquehanna River,

Based on lithologic information from wells installed during the SSI, a series of bedrock strike- and dip-oriented structural geologic cross-sections were constructed. Cross-section locations are shown on Plate 2 (Appendix C). Cross-sections A-A′ through E-E′ are provided in Plates 3, 4, and 5 for the Industrial Area. Cross-sections A-A′ and B-B′ for the North Base Landfill are shown on Plate 6. The published average bedrock dip angle and direction of 26 degrees NW (Meisler and Longwill, 1961) appears consistent with approximations of bedrock dip based on geophysical log correlations between wells, which can be made when the wells are in close proximity to one another. For the most part, however, due to the bedding dip, the discontinuous nature of the beds, and the lack of distinctive marker beds, it is not possible to make detailed stratigraphic correlations in the bedrock beneath the site.

2.3.4 *Hydrogeology*

The discussion in the three following paragraphs have been summarized primarily from the RI Report (Gannett Fleming, 1990b) which referenced published hydrogeologic reports pertaining to the Middletown area and the Site (Wood, 1980 and Meisler and Longwill, 1961).

Ground water at the Site occurs under unconfined (water table) conditions within the overburden and shallow bedrock, and both confined and unconfined conditions within the bedrock aquifer. The water table aquifer at the Site is present within terrace alluvium and the weathered upper zones of the Gettysburg Formation. The alluvium and weathered shallow bedrock do not yield significant quantities of water, but provide a permeable receptor for precipitation, which infiltrates rapidly, and provides recharge to the underlying bedrock aquifer system.

The unconfined aquifer extends to a depth of approximately 40 feet at the HIA and to a depth of approximately 20 feet in the North Base Landfill Area. At both locations the unconfined aquifer grades gradually into the underlying confined bedrock aquifers. Records of wells located in the area indicate that this aquifer is not extensively used. Because of the complex heterogeneous nature of bedding in the Gettysburg Formation, the exact location, extent, and hydraulic characteristics of individual aquifers at the Site are not well defined. Individual beds may be laterally extensive, but range in thickness from a few inches to a few feet.

Because some beds contain more openings than others, the confined ground water system in the Gettysburg Formation consists of a series of tabular-shaped aquifers that generally dip 26° to the northwest. The network of water-bearing fractures in each aquifer is reportedly more or less continuous along strike. Thus, the greatest movement of water in response to pumping is parallel to the strike of bedding which averages about N43°E. The continuity of individual beds is limited by faulting and pinching out. Aquifers in the Gettysburg Formation are reported to extend downdip from a few hundred feet to as much as 3,000 feet below land surface. The hydraulic connection between individual aquifers in the

Gettysburg Formation is reported to be generally poor, and wells deeper than 200 feet generally tap water from more than one aquifer.

Bedding plane partings provide a special class of fracture passages, not only because of their different origin, but also owing to their consistent orientation and greater lateral extent than any other fracture type. The larger areal extent of bedding discontinuities tends to reinforce the inherent permeability anisotropy of stratified rock masses due to fracture- and lithology-related permeability variations between individual beds. The presence of pervasive vertical fractures that project beyond individual bed boundaries provides for the "leaky" character of individual aquifer units, and would allow vertical movement of ground water and contaminant migration.

2.3.5 *Summary of Site Hydrogeology*

The general ground water flow direction throughout the study area is southward toward the Susquehanna River. The hydrogeology of the Site is primarily controlled by overburden and bedrock stratigraphy and structure. Other influences on hydrogeology at the Site include the Susquehanna River, ground water withdrawals associated with operation of the HIA well fields, local topography, and local precipitation.

Site topography provides a significant portion of the driving force behind ground water movement at the Site. The difference in elevation between the Susquehanna River and the North Base Landfill is approximately 100 feet, over a distance of approximately 10,000 feet. This translates to an average potentiometric surface gradient of 10 feet per 1,000 feet. This topographic effect on ground water movement results in a higher hydraulic gradient beneath the hill in the North Base Landfill area. Ground water elevation contour maps were constructed from data collected during a 8 and 9 May 1995 measurement event conducted as part of the SSI. Plates 7 and 8 (Appendix C) show elevation contours for overburden/shallow bedrock monitoring wells and intermediate monitoring wells, respectively. In both maps, influence from pumping well HIA-13 is clearly shown as a localized lowering of water levels. Differences in water elevation between adjacent shallow and intermediate nested wells are attributed to the presence of confined, hydraulically separate bedding plane aquifers and the fact that the two wells do not penetrate the same aquifers due to differences in well screen placement depths.

Overburden stratigraphy is variable, often containing man-made materials. Large areas of the Site are underlain by river terrace deposits, which are generally highly conductive (sand and gravel) with regard to ground water flow. The overburden at this Site underlies large areas of impermeable surfaces, such as runways, taxiways and buildings. These same areas are drained by a network of storm drains and sewers leading to the Susquehanna River. As a result, surface water runoff is greatly enhanced, and ground water recharge is reduced in these paved areas.

The lithology of the underlying Gettysburg Formation is predominately a silty sandstone to siltstone. The northeast striking and northwest dipping bedrock forms the basic framework for ground water movement. The bedding plane-controlled fracture system is preferentially interconnected in discrete zones, which are generally parallel to the strike direction of the Gettysburg Formation. In short, a conceptual model of the Gettysburg bedrock at the site embodies a leaky, multi-zone aquifer system that consists of thin bedding-plane-coincident flow zone units and much thicker, strata-bound, intervening confining units. Both the aquifer and confining units are part of a homoclinal structure capped by unconsolidated overburden of varying thickness across the site. The hydraulic behavior of such an heterogeneous structure is expected to be inherently anisotropic, with the least permeable axis oriented perpendicular to the bedding and preferential flow developing along the strike of the strata (northeast-southwest). Lithologic variations most likely do not influence Site hydrogeology as strongly as geologic structure. In the saturated bedrock, strike-oriented bedding plane partings and vertical fractures and joints will exert the most significant control on flow pathways.

The Susquehanna River also strongly influences hydrogeologic conditions at the HIA. The Susquehanna River drains a significant portion of north central and northeastern Pennsylvania and New York State, and consequently incorporates precipitation, surface water runoff, and ground water discharge from its large drainage basin. The Susquehanna is the major receptor of Site runoff, and has been thought to be a major ground water discharge point.

Ground water withdrawals from several pumping centers also strongly influence ground water flow at the Site. Currently, wells HIA-1, -2, -3, -4, -5, -6, -9, -11, -12, and -13 provide drinking water after treatment at the on site water treatment facility. Well HIA-14 is used exclusively for heating and cooling water for the airport terminal. Water withdrawals from production wells at the Site accentuate ground water movement along tabular bedding plane aquifers and can significantly increase flow from the overlying unconfined aquifer through open fractures that are interconnected with the water table aquifer. Exposures of distinct bedding plane fracture systems at the bedrock surface constitute the updip portion of the various tabular-shaped aquifers within the Gettysburg Formation. Downdip extensions of such zones reportedly continue to depths of 1,000 feet, even though compressive loads tend to reduce the primary porosity.

On the basis of usage, subsurface geology at the Site can be divided into three broad categories: overburden, shallow bedrock, and deep bedrock. Use of ground water from the deep bedrock is extensive. Use of ground water from the shallow bedrock is less extensive, and the overburden is not used as a direct water supply source. HIA and adjacent communities are dependent on deep bedrock ground water supplies. Since economical alternatives are not available, HIA treats its production well water to remove VOCs. Although the shallow bedrock aquifer is not directly used at the HIA, it is the vehicle of recharge from the overburden to the shallow and deep bedrock aquifers. Most airport production wells are cased to depths of 75 to 200 feet and are open from that depth to the total well depths of 450 to 800 feet.

The RI Report (Gannett Fleming, 1990b) stated that ground water recharge to the shallow bedrock aquifer carries contaminants from the overburden and that ground water movement through the bedrock occurs primarily in isolated fracture zones. Once ground water enters the bedrock from the overburden, it travels toward the Susquehanna River along bedding plane fractures. Also, the overburden aquifer generally displays higher and more uniform hydraulic conductivity, compared to the bedrock aquifers where significant hydraulic conductivity differences exist throughout the bedrock mass. Preferential fluid movement occurs in the unit with higher conductivity, which in this case is the overburden. However, there does not appear to be a consistent confining layer between the overburden and the bedrock, except at some portion of the North Base Landfill. As a result, communication between the two layers has provided a means for contamination to enter the bedrock aquifer.

In such a complex heterogeneous anisotropic fractured aquifer system, an equipotential surface cannot be used to interpret actual flow paths, but serves to indicate an apparent surface which is a composite of hydraulic heads of various aquifer units intercepted by individual wells.

2.3.6 *Site Ecology*

2.3.6.1 *Site Habitats*

A field reconnaissance survey was conducted during June 1995 to define major habitat covertypes and land uses occurring on and adjacent to the Middletown Airfield Site. Figure 2-3 is a Covertype Map illustrating the approximate location and extent of the identified natural habitats, based on vegetation community and land use covertypes. The following five natural habitat covertypes and five land use covertypes were identified on the site:

Natural Habitats

- Disturbed Herbaceous/Shrub Fill
- Riparian Zone
- Deciduous Upland Forest
- Forested Wetland
- Emergent Wetland

Land Uses

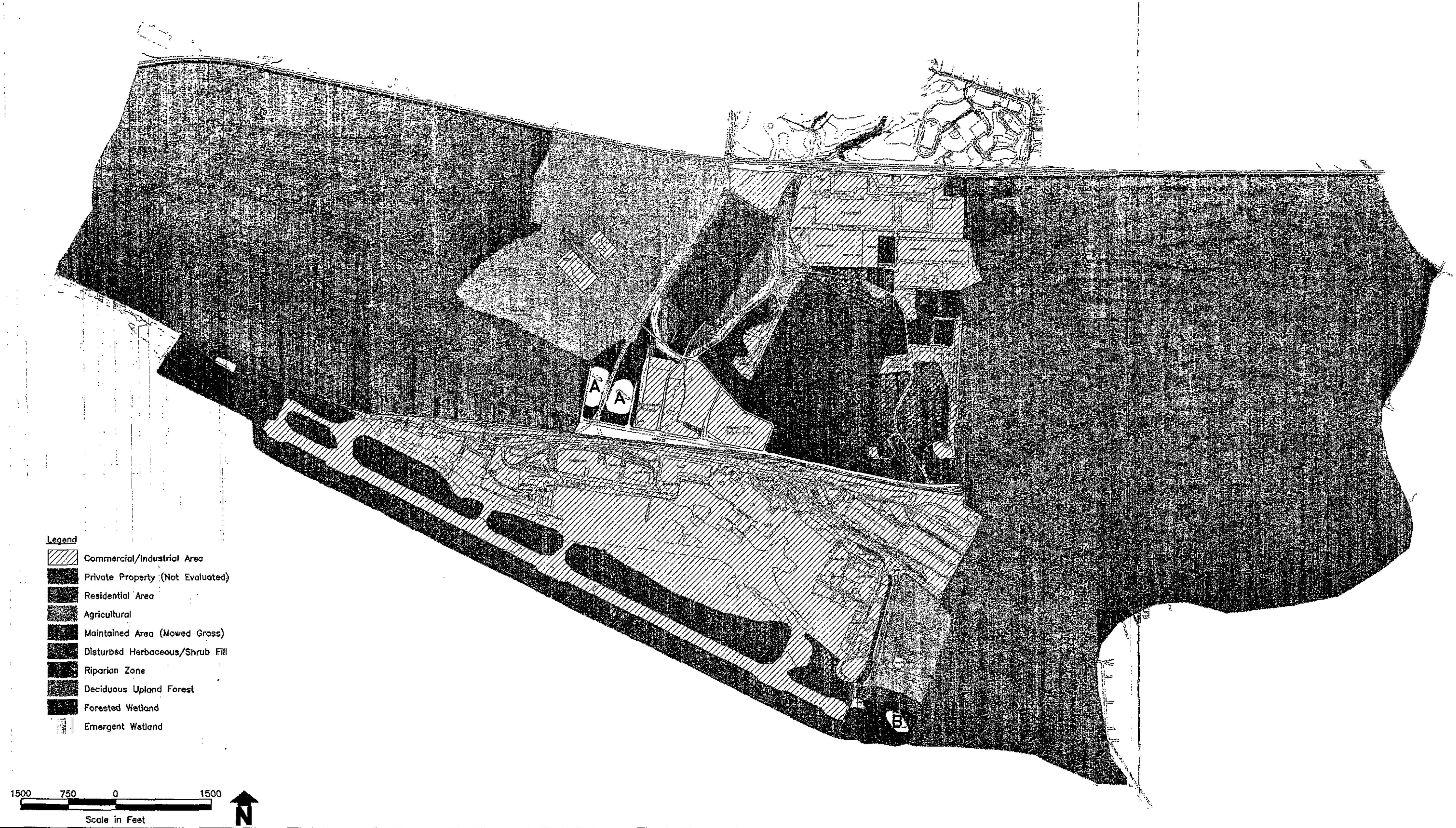
- Maintained Area
- Commercial/Industrial Area
- Private Property
- Residential Area
- Agricultural

A list of observed plant species that were identified in the natural habitat covertypes is provided in Table 2-1. Brief descriptions of both the natural and land use covertypes, as well as their approximate locations, are presented below.

Disturbed Herbaceous/Shrub Fill

The disturbed herbaceous/shrub fill covertype consists of herbaceous vegetation typical of disturbed areas and, to a lesser extent, various native and ornamental shrub and tree species. This covertype is typically found associated with fill areas, including the North Base Landfill and the bank of the Susquehanna River adjacent to the Runway Area. Smaller areas of

Figure 2-3
Covertype Map
Middletown Airfield NPL Site
Supplemental Studies Investigation
Middletown, Pennsylvania



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IMAGERY COVER SHEET
UNSCANNABLE ITEM

SITE NAME Middletown Airfield

OPERABLE UNIT

ADMINISTRATIVE RECORDS- SECTION ____ VOLUME II Appendices A-B

REPORT OR DOCUMENT TITLE Focused Feasibility Study Report - Volume I

DATE OF DOCUMENT July 1st 1996

DESCRIPTON OF IMAGERY Figure 2-3 Covertype Map Middletown Airfield NPL Site Supplemental Studies Investigation Middletown, PA

NUMBER AND TYPE OF IMAGERY ITEM(S) 1 oversized map

Table 2-1
List of Observed Vegetation Within Natural Habitat Covertypes
Supplemental Studies Investigation
Middletown Airfield, NPL Site
Middletown, Pennsylvania

Disturbed Herbaceous Fill

Tree Canopy		Shrub Understory		Herbaceous Ground Cover	
Black Locust	*Robinia pseudoacacia*	Autumn Olive	*Elaeagnus umbellata*	Asiatic Tearthumb	*Polygonum perfoliatum*
Black Willow	*Salix nigra*	Black Raspberry	*Rubus occidentalis*	Birdfoot Trefoil	*Lotus corniculatus*
Box Elder	*Acer negundo*	Blackberry	*Rubus allegheniensis*	Bittersweet nightshade	*Solanum dulcamara*
Southern Catalpa	*Catalpa bignonioides*	Multiflora Rose	*Rosa multiflora*	Black Eyed Susan	*Rudbeckia hirta*
Pin Oak	*Quercus palustris*	Poison Ivy	*Toxicodendron radicans*	Brome Grass	*Bromus spp.*
Princess Tree	*Paulownia tomentosa*	Rye Grass	*Lolium sp.*	Bull Thistle	*Cirsium vulgare*
Red Maple	*Acer rubrum*	Staghorn Sumac	*Rhus typhina*	Canada Thistle	*Cirsium arvense*
Tree-of-Heaven	*Ailanthus altissima*	Tartarian Honeysuckle	*Lonicera tatarica*	Common milkweed	*Asclepias syriaca*
White Ash	*Fraxinus americana*			Common Mullein	*Verbascum thapsus*
White Mulberry	*Morus alba*			Crown Vetch	*Coronilla varia*
				Curled Dock	*Rumex crispus*
				Daisy Fleabane	*Erigeron annuus*
				Garlic Mustard	*Allaria officinalis*
				Goldenrod	*Solidago sp.*
				Hedge bindweed	*Convolvulus sepium*
				Japanese Honeysuckle	*Lonicera japonica*
				Kudzu	*Pueraria lobata*
				Moth Mullein	*Verbascum blattaria*
				Orchard Grass	*Dactylis glomerata*
				Ox-Eye Daisy	*Chrysanthemum leucanthemum*
				Peppermint	*Mentha piperita*
				Poison Ivy	*Toxicodendron radicans*
				Pokeweed	*Phytolacca americana*
				Purple Loosestrife	*Lythrum salicaria*
				Purple Milkweed	*Asclepias purpurascens*
				Redtop	*Agrostis alba*
				Rough Avens	*Geum virginianum*
				Spotted Knapweed	*Centaurea maculosa*
				Spreading Dogbane	*Apocynum androsaemifolium*
				Teasle	*Dipsacus laciniatus*
				Timothy	*Phleum pratense*
				Virginia Creeper	*Parthenocissus quinquefolia*
				White Aster	*Aster vimineus*
				White Sweet Clover	*Melilotus alba*
				Yellow Sweet Clover	*Melilotus officinalis*

Table 2-1 (con't)
List of Observed Vegetation Within Natural Habitat Covertypes
Supplemental Studies Investigation
Middletown Airfield, NPL Site
Middletown, Pennsylvania

Riparian Zone

Tree Canopy		Shrub Understory		Herbaceous Ground Cover	
American Elm	*Ulmus americana*	Black Raspberry	*Rubus occidentalis*	American Bittersweet	*Celastrus scandens*
American Sycamore	*Platanus occidentalis*	Common Privet	*Ligustrum vulgare*	Bull Thistle	*Cirsium vulgare*
Black Cherry	*Prunus serotina*	Multiflora Rose	*Rosa multiflora*	Canada Goldenrod	*Solidago canadensis*
Black Locust	*Robinia pseudoacacia*	Poison Ivy	*Toxicodendron radicans*	Common boneset	*Eupatorium perfoliatum*
Black Willow	*Salix nigra*	Silky Dogwood	*Cornus amomum*	Common Morning Glory	*Ipomoea purpurea*
Box Elder	*Acer negundo*	Staghorn Sumac	*Rhus typhina*	Crown Vetch	*Coronilla varia*
Cottonwood	*Populus deltoides*	Tartarian Honeysuckle	*Lonicera tatarica*	Curled Dock	*Rumex crispus*
Princess Tree	*Paulownia tomentosa*	Wild Grape Vine	*Vitis spp.*	Daisy Fleabane	*Erigeron annuus*
Sassafrass	*Sassafras albidum*			English Plaintain	*Plantago laceolata*
Silver Maple	*Acer saccharinum*			Goldenrod	*Solidago sp.*
				Hedge bindweed	*Convolvulus sepium*
				Japanese Honeysuckle	*Lonicera japonica*
				Jewelweed	*Impatiens capensis*
				Kudzu	*Pueraria lobata*
				Lance-leaved Goldenrod	*Euthamia graminifolia*
				Moth Mullein	*Verbascum blattaria*
				Mint	*Pycnanthemum muticum*
				Onion Grass	*Allium sp.*
				Ox-Eye Daisy	*Chrysanthemum leucanthemum*
				Peppermint	*Mentha piperita*
				Poison Ivy	*Toxicodendron radicans*
				Pokeweed	*Phytolacca americana*
				Reed Canary Grass	*Phalaris arundinacea*
				Spotted Knapweed	*Centaurea maculosa*
				Spreading Dogbane	*Apocynum androsaemifolium*
				Virgina knotweed	*Polygonum virginianum*
				Virginia Creeper	*Parthenocissus quinquefolia*
				Water Hemlock	*Cicuta maculata*
				White Aster	*Aster vimineus*
				Yellow Sweet Clover	*Melilotus officinalis*

Table 2-1 (con't)

List of Observed Vegetation Within Natural Habitat Covertypes

Supplemental Studies Investigation

Middletown Airfield, NPL Site

Middletown, Pennsylvania

Deciduous Upland Forest

Tree Canopy		Shrub Understory		Herbaceous Ground Cover	
American Elm	*Ulmus americana*	Black Raspberry	*Rubus occidentalis*	American Bittersweet	*Celastrus scandens*
Black Cherry	*Prunus serotina*	Multiflora Rose	*Rosa multiflora*	Bull Thistle	*Cirsium vulgare*
Black Locust	*Robinia pseudoacacia*	Poison Ivy	*Toxicodendron radicans*	Common Mullein	*Verbascum thapsus*
Black Walnut	*Juglans nigra*	Spicebush	*Lindera benzoin*	Crown Vetch	*Coronilla varia*
Black Willow	*Salix nigra*	Staghorn Sumac	*Rhus typhina*	Deptford Pink	*Dianthus armeria*
Box Elder	*Acer negundo*	Tartarian Honeysuckle	*Lonicera tatarica*	Evening primrose	*Oenothera biennis*
Southern Catalpa	*Catalpa bignonioides*	Wild Grape Vine	*Vitis spp.*	Garlic Mustard	*Allaria officinalis*
Pin Oak	*Quercus palustris*			Goldenrod	*Solidago sp.*
Princess Tree	*Paulownia tomentosa*			Great Burdock	*Arctium lappa*
Red Maple	*Acer rubrum*			Heal-All	*Prunella vulgaris*
Red Oak	*Quercus rubra*			Japanese Honeysuckle	*Lonicera japonica*
Silver Maple	*Acer saccharinum*			Peppermint	*Mentha piperita*
Tree-of-Heaven	*Ailanthus altissima*			Poison Ivy	*Toxicodendron radicans*
Tulip Tree	*Liriodendron tulipifera*			Pokeweed	*Phytolacca americana*
White Ash	*Fraxinus americana*			Rough Avens	*Geum virginianum*
White Mulberry	*Morus alba*			Virginia Creeper	*Parthenocissus quinquefolia*
White Oak	*Quercus alba*				

Table 2-1 (con't)
List of Observed Vegetation Within Natural Habitat Covertypes
Supplemental Studies Investigation
Middletown Airfield, NPL Site
Middletown, Pennsylvania

Forested Wetland

Tree Canopy		*Shrub Understory*		*Herbaceous Ground Cover*	
Black Willow	*Salix nigra*	Poison Ivy	*Toxicodendron radicans*	Clearweed	*Pilea pumila*
Box Elder	*Acer negundo*	Red Maple Saplings	*Acer rubrum*	Evening primrose	*Oenothera biennis*
Red Maple	*Acer rubrum*	Silky Dogwood	*Cornus amomum*	Jewelweed	*Impatiens capensis*
Silver Maple	*Acer saccharinum*	Tartarian Honeysuckle	*Lonicera tatarica*	Mild Water Pepper	*Polygonum hydropiperoides*
				Reed Canary Grass	*Phalaris arundinacea*
				Stinging Nettle	*Urtica dioica*
				Swamp Milkweed	*Asclepias incarnata*
				Sweet Flag	*Acorus calamus*

Emergent Wetland A

Tree Canopy		*Shrub Understory*		*Herbaceous Ground Cover*	
Black Willow	*Salix nigra*	Red Maple Saplings	*Acer rubrum*	American burreed	*Sparganium americanum*
Box Elder	*Acer negundo*	Silky Dogwood	*Cornus amomum*	Arrow Arum	*Peltandra virginica*
				Arrow-leaved tearthumb	*Polygonum sagittatum*
				Birdfoot Trefoil	*Lotus corniculatus*
				Broad-leaf cattail	*Typha latifolia*
				Clearweed	*Pilea pumila*
				Jewelweed	*Impatiens capensis*
				Joe-Pye-Weed	*Eupatorium dubium*
				Poison Ivy	*Toxicodendron radicans*
				Purple Loosestrife	*Lythrum salicaria*
				Reed Canary Grass	*Phalaris arundinacea*
				Rough Avens	*Geum virginianum*
				Rough Bedstraw	*Galium asprellum*
				Tumble Mustard	*Sisymbrium altissimum*
				Woolgrass	*Scirpus cyperinus*

Emergent Wetland B

Tree Canopy		*Shrub Understory*		*Herbaceous Ground Cover*	
None		None		American burreed	*Sparganium americanum*
				Arrow Arum	*Peltandra virginica*
				Broad-leaf cattail	*Typha latifolia*
				Jewelweed	*Impatiens capensis*

Table 2-1 (con't)
List of Observed Vegetation Within Natural Habitat Covertypes
Supplemental Studies Investigation
Middletown Airfield, NPL Site
Middletown, Pennsylvania

Shrub/Scrub Emergent Wetland (General)

Tree Canopy		*Shrub Understory*		*Herbaceous Ground Cover*	
Black Willow	*Salix nigra*	Red Maple Saplings	*Acer rubrum*	American burreed	*Sparganium americanum*
Tree-of-Heaven	*Ailanthus altissima*	Silky Dogwood	*Cornus amomum*	Arrow Arum	*Peltandra virginica*
		Spicebush	*Lindera benzoin*	Arrow-leaved tearthumb	*Polygonum sagittatum*
				Barnyard grass	*Echinochloa crusgalli*
				Bittersweet nightshade	*Solanum dulcamara*
				Broad-leaf cattail	*Typha latifolia*
				Clearweed	*Pilea pumila*
				Common milkweed	*Asclepias syriaca*
				Common reed	*Phragmites*
				Common St. Johns Wort	*Hypericum perforatum*
				Evening primrose	*Oenothera biennis*
				False Nettle	*Boehmeria cylindrica*
				Fox Sedge	*Carex vulpinoidea*
				Garlic Mustard	*Allaria officinalis*
				Goldenrod	*Solidago sp.*
				Jewelweed	*Impatiens capensis*
				Lady's Thumb Smartweed	*Polygonum persicaria*
				Lurid Sedge	*Carex luride*
				Narrow-leaf Cattail	*Typha angustifolia*
				Purple Loosestrife	*Lythrum salicaria*
				Redtop	*Agrostis alba*
				Reed Canary Grass	*Phalaris arundinacea*
				Rough Avens	*Geum virginianum*
				Rough Bedstraw	*Galium asprellum*
				Skunk Cabbage	*Symplocarpus foetidus*
				Soft Rush	*Juncus effusus*
				Beaked Spike Rush	*Eleocharis rostellata*
				Spreading Dogbane	*Apocynum androsaemifolium*
				Tumble Mustard	*Sisymbrium altissimum*
				Woolgrass	*Scirpus cyperinus*

this covertype are located at either end of the runway and in the vicinity of the Route 441 interchange.

The disturbed herbaceous/shrub fill covertype is dominated by bull thistle, Canada thistle, common milkweed, common mullein, crown vetch, curled dock, daisy fleabane, garlic mustard, goldenrod, Japanese honeysuckle, pokeweed, spotted knapweed, spreading dogbane, teasel, white sweet clover and yellow sweet clover. Shrub and tree species common to this covertype include staghorn sumac, multiflora rose, box elder, red maple, and tree-of-heaven.

Riparian Zone

The riparian zone is comprised of a narrow band of vegetation adjacent to Post Run on the eastern portion of the site. This covertype is dominated by a mixture of deciduous trees, shrubs and herbaceous plants characteristic of both upland and wetland communities. Although the riparian zone is not classified as a wetland area, the unique mixture of wetland and upland species in this zone is the result of its proximity to Post Run. The water table in this area is likely higher than surrounding areas, and inundation from flooding allows the establishment of plant species adapted to wet soil conditions.

The riparian zone covertype is dominated by trees such as American sycamore, silver maple, American elm, black willow, black cherry and box elder. The shrub understory is dominated by common privet, multiflora rose, silky dogwood, staghorn sumac and tartarian honeysuckle. Ground cover in the riparian zone is dominated by bull thistle, Canada goldenrod, crown vetch, curled dock, Japanese honeysuckle, jewelweed, lance-leaved goldenrod, reed canary grass, spotted knapweed, Virginia creeper and Yellow sweet clover.

Deciduous Upland Forest

The deciduous upland forest covertype is located adjacent to the Meade Heights housing area and east of the wastewater treatment lagoons. This covertype is composed primarily of a successional tree canopy and shrub understory. Due to the nearly complete aerial cover in this community, ground cover is limited to relatively few herbaceous species.

The tree canopy of the deciduous upland forest covertype is dominated by American elm, black cherry, black locust, black walnut, princess tree, red maple, red oak, tulip tree, white ash and white oak. The shrub understory is dominated by multiflora rose, spicebush, staghorn sumac and tartarian honeysuckle. Herbaceous ground cover includes garlic mustard, common mullein, goldenrod, Japanese honeysuckle, poison ivy, great burdock, rough avens and Virginia creeper.

Forested Wetland

Two forested wetland areas were identified on the Site. One area is located at the eastern end of the Runway Area, and the second area is located at the western end of the Runway. This covertype is dominated by tree and shrub species. Similar to the deciduous upland forest covertype, due to the nearly complete aerial cover in this community, ground cover is limited to relatively few herbaceous species.

The tree canopy of the forested wetland covertype is dominated by black willow, box elder, red maple and silver maple. The shrub understory is dominated by poison ivy, red maple saplings, silky dogwood and tartarian honeysuckle. Herbaceous ground cover includes clearweed, jewelweed, mild water pepper, stinging nettle and reed canary grass.

Emergent Wetland

The emergent wetland covertype is primarily associated with lowlying areas adjacent to streams and depressional areas. Emergent wetlands were identified at the North Base Landfill, along the Meade Heights tributary and portions of Post Run, and associated with the forested wetlands located at either end of the Runway Area. The covertype is characterized by the dominance of hebaceous species and the presence of standing water. The dominant species which are characteristic overall of the observed emergent wetlands are discussed below. More detailed information on the dominant species present in the Emergent Wetland Areas A and B is presented in Table 2-1.

The emergent wetland covertype is generally dominated by tree and shrub species which include black willow, box elder, red maple saplings, silky dogwood and spicebush. Herbaceous ground cover generally includes American burred, arrow arum, arrow-leaved tearthumb, broad-leaf cattail, clearweed, common reed, evening primrose, false nettle, fox sedge, garlic mustard, goldenrod, jewelweed, lurid sedge, reed canary grass, skunk cabbage, soft rus, spreading dogbane and woolgrass.

Maintained Area

The maintained area land use covertype consists of areas of maintained lawns. This covertype is present throughout the Penn State campus and along the HIA Runway Area.

Commercial/Industrial Area

The commercial/industrial area land use covertype represents the area occupied by the Penn State campus, the Jamesway shopping center and the Smart Park rental car parking lots, and the HIA Industrial Area. These areas consist primarily of structures, pavement and maintained areas and are indicated on Figure 2-3.

Private Property

The private property land use covertype consists of the Oddfellow Retirement Home and grounds. This property is not part of the former Olmsted AFB and was, therefore, not evaluated as part of the habitat characterization field study.

Residential Area

The residential area land use covertype consists of the residential areas which are located both east and west of the Site, as well as the Meade Heights housing area.

Agricultural

The agricultural land use covertype is located west of the Meade Heights area along the western side of Route 441 and south of Route 283.

2.3.6.2 *Potential Receptors*

As described above, the Middletwon Airfield site is almost entirely developed for industrial and urban uses, and there is very little undisturbed natural habitat. According to information provided in the Final Remedial Investigation for the Middletown Airfield Site prepared by NUS Corporation (1990), studies performed at the site identified terrestrial species typical of disturbed areas such as the house sparrow, European starling and common grackle. In addition, possible game animals that may occasionally be found on-site include the mourning dove, cottontail rabbit, gray squirrel, groundhog, muskrat, raccoon and striped skunk (NUS, 1990).

Several studies have been conducted to assess the aquatic community of the Susquehanna River in the vicinity of the Harrisburg International Airport (NUS, 1990). Twenty taxa of macroinvertebrates and six species of fish were found in the River. The most abundant macroinvertebrae taxa were amphipods and two species of mayflies. The fish species identified included rosyface shiner, spotfin shiner, white sucker, pumpkinseed, bluegill and smallmouth bass.

A stream survey of the Meade Heights tributary was conducted by ERM during May 1994. The report documenting the methods and results of this survey is provided in Appendix G. Twenty-three taxa of macroinvertebrates and two species of fish were identified in the tributary. The most abundant macroinvertebrate taxa were species of stoneflies, caddisflies and midges. The fish species identified included blacknose dace and creek chub.

Threatened and Endangered Species

No federal or state threatened or endangered species are located in the vicinity of the Middletown Airfield Site according to information obtained by NUS Corporation from the Pennsylvania Natural Diversity Inventory (GF, 1990). In addition, according to the NUS report dated 10 August 1984, no critical environments were identified within a one-mile radius of the site.

The Pennsylvania Game Commission reports that the osprey and bald eagle may utilize the Susquehanna River in the vicinity of the site for feeding. However, it is unlikely that these species would utilized the Middletown Airfield Site due to its industrial and urban nature, and the disturbance caused by the large amount of air traffic at the airport (GF, 1990).

2.3.7 *Climatology*

General climatic conditions at the Site are characterized by a humid continental climate. The average annual precipitation in the vicinity of the site ranges from 38.83 inches at York Haven, Pennsylvania, to 42.97 inches at Ephrata, Pennsylvania. Mean annual precipitation in the site vicinity is approximately 41 inches. Precipitation is generally well distributed throughout the year, although average summer rainfall is slightly higher than other seasons. Monthly extremes range from 0.43 to 8.43 inches. Dry spells can occur at any time, but extended periods of drought are rare. Approximately 60 percent of the annual total precipitation occurs from April to October, and about one-tenth of the total annual precipitation is snow (GF, 1990b).

2.4 *INVESTIGATIONS AND REMEDIAL ACTIONS COMPLETED TO DATE*

In March 1983, TCE was discovered in six HIA production wells triggering subsequent environmental investigations and studies, and the installation of the water treatment system that is currently in use. In 1988, the USEPA initiated a CERCLA RI/FS to determine the extent of contamination and possible remedial measures.

Several other investigations of the Site have been performed. JRB Associates, Inc., performed a Phase I - Problem Identification Records Search of the Site under the Department of Defense's Installation Restoration Program (IRP) in 1984. R. E. Wright Associates, Inc., investigated the former landfill located beneath the main HIA runways in 1984 to determine if that area was contributing to the contamination of production wells located in the Industrial Area. Based on ground water flow patterns and the types of contaminants, R. E. Wright concluded that the Runway Area landfill was most likely not the source of contamination to the production wells.

A IRP Phase II - Confirmation/ Quantification Stage 1 investigation was performed in 1985 by Roy F. Weston, Inc. The areas investigated included Lisa Lake, Meade Heights, the North Base Landfill, the Runway Area, and the Industrial Area. Ground penetrating radar and magnetometer surveys were performed at the Runway, Industrial, and North Base Landfill Areas. As a result of the surveys, nine partially exposed 55-gallon drums were removed from a fill area located along a stream bank northeast of the Meade Heights housing complex. The drums were empty except for water and coatings of a hard, black tarry substance. These contents were sampled and found to be nonhazardous under the USEPA characteristic of EP toxicity. Seven wells were installed at the Site to further identify and characterize areas of concern.

Remedial actions for the HIA production wells were addressed in the U.S. Air Force and PA DOT's Focused Feasibility Study (1987), and Buchart-Horn, Inc.'s Phase IV - Corrective Action Study (1986). An air stripping tower was installed at the wellhead of production well HIA-11 to lower

VOCs to meet drinking water standards. This system was eliminated when the water treatment plant was constructed.

The water treatment system currently in use at the Site is capable of treating water from all HIA production wells. The treatment system includes an ion exchange unit for water softening and an air stripper for reducing the VOCs. The water is chlorinated before redistribution to HIA tenants, PAANG, the Oddfellows Home, the Penn State Capital Campus, the Meade Heights residential area, and the Fruehauf Corporation facilities.

A train spill occurred northwest of the Runway Area at the HIA on 4 June 1988, approximately 500 feet west of Production Well HIA-12. Diethylene glycol and mineral oil were released as a result of the spill. Remediation at the Site was initiated which included pumping ground water into settling tanks where skimming of the mineral oil occurred, biotreatment of the diethylene glycol, and reinjection of the treated water into the subsurface. Remediation was completed in spring of 1989.

In 1989, an RI was conducted at the Site which investigated five areas to evaluate the geology and determine the concentrations of contaminants in soils, ground water, surface water and sediments. A total of 21 overburden monitoring wells, 14 bedrock monitoring wells, and 39 subsurface soil borings were drilled during the investigation. Two rounds of ground water samples were collected at each of the new wells installed as well as from 17 existing monitoring and production wells. One round of samples were collected from five residential wells and a nearby production well in the Borough of Middletown. Soil samples were collected at three depths for each soil boring, and three soil samples were collected at each monitoring well. In addition, one round of surface water and sediment samples were collected from 24 separate locations on the Site.

In addition to the ground water sampling at the site during the RI, aquifer testing was also performed. Slug testing was performed at newly installed wells, where applicable, and packer testing was performed at six bedrock wells. Three 24-hour pumping tests were performed after short-term step-drawdown testing. A fourth pumping test was stopped after 11 hours due to torrential rain showers. Well hydrograph stations were used to record well water levels to determine influences from pumping, recharge, and the Susquehanna River.

The RI report (Gannett Fleming, 1990b) and FS Report (Gannett Fleming, 1990a) provided the basis for the USEPA's December 1990 ROD for Operable Unit 2. The PADEP asserted that the ROD did not fully investigate the relationship between soil and ground water contamination, nor did it consider active soil cleanup technologies. The USEPA incorporated PADEP concerns into an ESD document which required additional studies to address PADEP concerns. The ESD required performance of the SSI to gather additional data to determine:

- the extent of ground water contamination,
- the capture zone and timetable for ground water restoration, and
- the impact of soils on ground water remediation.

2.5 *SUPPLEMENTAL STUDIES INVESTIGATION OBJECTIVES*

The purpose of the SSI was to perform the supplemental study requirements described in the 17 December 1990 ROD, as clarified by the 30 December 1992 ESD for the Site. Descriptions of investigation activities and laboratory analyses conducted as part of the SSI and figures showing sampling locations are provided in Appendix D. Specific objectives of the investigation activities were to:

- assess the potential impact of contaminated soil on ground water in and around the Industrial Area, North Base Landfill, and Runway;
- repeat previous USEPA sampling of the Susquehanna River to verify that concentrations of site-related contaminants are below AWQC levels;
- evaluate water quality and organisms in the stream flowing through the Meade Heights Area;
- install monitoring/sentinel wells between the North Base Landfill and Middletown production well MID-04 to provide warning of potential plume impacts on MID-04;
- perform a hydrogeologic investigation of shallow and deep ground water to determine the extent of contamination and a capture zone, including evaluation of existing wells and new wells, as necessary to characterize the hydrogeologic regime at the site, and assist in development of a ground water restoration timetable;
- evaluate soil vapor extraction (SVE) as a potential soil cleanup method to enhance ground water cleanup within a reasonable time frame and conduct a SVE pilot study;

- evaluate the best configuration for production wells and their pumping rates to maximize containment of identified plumes;
- develop a timetable for ground water restoration; and
- perform quarterly monitoring of the Susquehanna River and the Sentinel wells at the North Base Landfill.

The investigation approach was to assess the potential impact of soil on ground water quality based on the use of field screening analysis of soil vapor and soil samples collected using direct push sampling methods. Based on analytical field screening results, soil boring sampling locations were selected and samples analyzed by an on-site mobile laboratory. The on-site lab was validated by the USACE's Missouri River Division (MRD) laboratory to provide Level III data using SW846 Method 8260 GC/MS analysis for TCL VOCs plus TICs. Each task relied on data generated by the proceeding tasks in an effort to focus subsequent sampling efforts to pinpoint the source and extent of soil contamination. For example, the investigation of the pipeline from Building 142 to the lagoons was initiated with a dye study over a portion of the line in an attempt to identify potential leaks. Next, a direct push soil vapor survey was performed along the pipeline, followed by direct push soil sampling at locations with elevated soil vapor levels followed by soil borings and the collection of split spoon samples, and finally monitoring well installation.

Soils were investigated within the Industrial Area in the vicinity of the former Waste Sump House (Building 257) and along the Building 142/267 pipelines and the lagoons. Direct push soil vapor sampling was conducted at intervals of 100 feet or less along the pipeline which resulted in 81 sample locations. Upon completion of the soil vapor sampling, soil samples were collected at two depths from 20 locations using direct push methods. Based on the screening results for the direct push soil vapor and soil samples, 12 soil boring locations were sampled along the pipelines and the lagoons. Additional soil borings were sampled at 30 locations within the Main Building Area of the Industrial Area and 5 locations in the Runway Area.

The hydrogeologic investigation included the installation of 35 wells in the Industrial Area, 27 wells in the North Base Landfill Area and 5 wells in the Runway Area. As part of the hydrogeologic investigation of deep ground water contamination, 3 HIA production wells were video-surveyed, geophysically logged, and sampled at five depth-specific intervals in an attempt to identify the depth at which contamination is transported within the bedrock aquifer system.

3.0 BASELINE RISK ASSESSMENT

The Focused Feasibility Study (FFS) for the Middletown Airfield NPL Site included a baseline risk assessment (BRA). The objective of this assessment was to evaluate potential risks associated with soil, ground water, surface water and sediment data collected during the Supplemental Studies Investigation (SSI) and other recent sampling events. In the assessment, potential risks to both human and ecological receptors were considered under current and realistic future use conditions. Results of the BRA were used, together with other risk management criteria, to define remedial action objectives for the FFS (Section 4).

For this FFS, the BRA was limited to a screening assessment for both health and ecological evaluations; that is, constituent concentrations were compared to appropriate screening criteria, and any concentrations exceeding screening criteria were assessed qualitatively. This approach was developed and discussed extensively with USEPA Region III prior to submittal of the FFS report.

Section 3 presents the BRA for the Middletown Site, as described below:

- Section 3.1 summarizes the data to be evaluated in this BRA;
- Section 3.2 discusses the results of the human health screening evaluation;
- Section 3.3 presents the ecological screening evaluation; and
- Section 3.4 summarizes the results of the BRA.

The results of the data comparisons to the various screening criteria are presented in Appendix F.

3.1 DATA EVALUATION

The following subsection summarizes the analytical data for environmental samples collected across the Site during the SSI and discusses the results with respect to the trends identified from the Remedial Investigation (RI) performed previously for the Middletown Site. The areas investigated as part of the SSI included the following:

- Industrial Area;

- Runway Area;
- North Base Landfill;
- Susquehanna River; and
- Meade Heights.

In addition, the SSI included a radiological survey, in which ground water samples and wipe samples from the storm sewer vaults were evaluated for radium-226. Data from each of these components of the SSI are briefly described below. Data collected by Smith Environmental Technologies Corporation are also discussed; these data were collected as part of a parallel study of the Site and surrounding areas undertaken by the Pennsylvania Department of Transportation (PennDOT).

Detailed discussion of the sampling methods used in the SSI and figures showing sampling locations are provided in Appendix D. Analytical data for all samples collected during the SSI are provided in Appendix E.

3.1.1 *Industrial Area*

3.1.1.1 *Soils*

The previous RI Report (GF, 1990b) stated that soil samples collected in the Industrial Area did not appear to be a source of volatile organic compounds (VOCs) to ground water; however relatively high concentrations of semivolatile compounds were detected. Hot spots were identified, based on the presence of high concentrations detected in soil samples collected during drilling of monitoring wells GF-318 in the vicinity of the Waste Sump House (Building 262) and wells GF-217, -222, and -227 in the vicinity of Stambaugh Aviation (Building 133).

Soil sample intervals in the well GF-318 borehole were at 8 and 20 feet below land surface (BLS). No organic compounds were detected in the 8 foot soil sample interval, but elevated levels of chlorobenzene and dichlorobenzene were reported in the sample collected from 20 feet BLS. This sample was collected approximately 5 feet below the water table (i.e., the water table was measured at about 15 feet BLS in this well). The RI Report attributed the elevated levels of chlorobenzene and dichlorobenzene in the 20 foot BLS sample to soil conditions. However, based on the fact that no organic compounds were found in the 8 foot BLS sample, it appears that the presence of the chlorinated benzenes in the 20 foot BLS sample likely reflects ground water conditions rather than soil conditions.

Soil samples collected from multiple intervals of the borehole for well GF-217 detected only phthalates. No organic compounds were quantitatively confirmed in samples above the water table in the borehole for well GF-222. Soil samples collected above the water table from the well GF-227 borehole adjacent to the northeast corner of the Stambaugh Hangar did detect fuel-related volatiles and polycyclic aromatic hydrocarbon (PAH) compounds.

Based on the results of the RI, soil sampling in the SSI focused on these "hotspots;" samples were also collected along the Building 142 and 267 pipelines and adjacent to the Lagoons. The results of this sampling are summarized below.

- The primary constituents found in soil samples from throughout the Industrial Areas were PAHs. These semivolatile compounds are formed during the heating of petroleum mixtures, and are associated with asphalt, runway and roadway runoff, jet exhaust, fossil fuel power plant emissions, etc.[1] Thus, these compounds are associated with many of the routine operations at an airport. The composition of PAH emissions varies with the type of source. As one would expect (in light of their many potential sources), PAHs are commonly found in urban and industrial areas (Menzie et al., 1992: ATSDR, 1993d).
- Inorganic constituents were consistently detected in soil samples. These are naturally occurring components of soils. Reported ranges of these constituents were generally consistent with levels found in background samples collected as part of the SSI.
- Only isolated detections of VOCs were found in any of the soil samples collected in the Industrial Areas.

3.1.1.2 *Ground Water*

The RI Report indicated that ground water contamination was widespread and that the area around the Stambaugh Hangar was classified as a hotspot because of the presence of VOCs and inorganic constituents. The RI also stated that, except for chlorobenzene and dichlorobenzene, none of

1 PAHs are also associated with numerous nonindustrial sources, such as wood-burning stoves and fireplaces, auto exhaust, charcoal grills, etc. Natural sources, such as volcanoes and forest fires, also produce PAHs.

the constituents detected in ground water were present at high concentrations in the soil. As explained above, the elevated levels of chlorobenzene and dichlorobenzene attributed to the soils were detected in a soil sample collected below the water table in the borehole for well GF-318. The statement made in the RI Report that none of the constituents detected in the ground water were present at high concentrations in the soils was confirmed by the data collected during the SSI.

Trichloroethene (TCE) and carbon tetrachloride were the most commonly detected VOCs above federal Maximum Contaminant Levels[1] (MCLs) in ground water samples collected from monitoring wells within the Industrial Area. Map Plates 9 through 11 in Appendix C provide isoconcentration maps for TCE in the overburden, intermediate and deep bedrock aquifer zones. TCE was detected at the highest level, and was the most widespread constituent, extending eastward from Building 142 to the PAANG area. The highest level was detected in well RFW-03, located approximately 10 feet south of the southern wall of Building 142, immediately adjacent to HIA -13. The detection of carbon tetrachloride was highest in well GF-315, located in the central part of the Industrial Area; detectable concentrations extended east to the PAANG area. Vinyl chloride was detected above its MCL only in overburden well GF-218, located near the Waste Sump House (Building 262).

TCE was detected above its MCL in ground water samples collected from HIA production wells HIA-10, HIA-13, and HIA-14 in the Industrial Area. 1,2-Dichloroethene (1,2 DCE) also exceeded its MCL in well HIA-13. Dieldrin and bis(2-ethylhexyl)phthalate (DEHP) exceeded MCLs in well HIA-2.

The only dissolved metal to exceed its MCL was nickel in ground water samples from monitoring wells RFW-4 and ERM-23D. These wells are located south of Building 142.

3.1.1.3 Storm Sewer Sediments

As part of the SSI, sediment samples were collected from the storm sewers in the Industrial Area (Appendix D, Figure D-7). Elevated levels of organic and inorganic constituents were detected in Vault J-5 of the storm sewer system (approximately 100 feet west of the southwestern corner of

1 The 1987 ROD for Operable Unit 1 of the Middletown Airfield NPL Site established MCLs as the target cleanup levels for ground water.

Building 208) during the SSI. The USACE is currently seeking a contractor to clean Vault J-5, and remove the sediment from the storm sewer. The remainder of the storm sewer system will be addressed as part of the on-going storm sewer discharge permitting process. The Stormwater NPDES Permit is expected to be in effect by the end of July 1996 (Personal Communication with Fran Strauss, June 1996).

3.1.2 *Runway Area*

3.1.2.1 *Soils*

The RI Report (GF, 1990b) indicated that, from the mid-1940s through 1956, wastes from base operations were either incinerated or landfilled in this area. In 1956, a runway construction program was initiated and slag was transported from the former Bethlehem Steel plant located several miles upriver for use as fill. Analytical results for soil samples collected from the Runway Area as part of the RI indicated the most widespread constituents were PAHs, phthalates, 1,2-DCE, and TCE.

In general, the number of compounds detected and their concentrations were less in the soil samples collected during the SSI than in the samples collected in the RI. Borings RA-SB53 through RA-SB55 were located south of the runway in slag-dominated fill, in the same general location as the RI soil boring locations (Appendix D, Figure D-5). PAHs were generally detected at depths greater than 10 feet BLS, and coincided with the depth at which slag was encountered in these borings. Estimated concentrations of TCE, 1,2 dichlorobenzene, acetone and vinyl acetate were also detected in samples collected below 8 feet. One PCB Aroclor was detected in only the 10 to 12 foot sample interval in Boring RA-SB55. Borings RA-SB56 and -SB57 did not encounter slag. PAHs were detected in RA-SB56 at a depth of 6 feet which was the shallowest interval sampled in that boring. DEHP was detected in all samples collected from borings RA-SB56 and RA-SB57.

3.1.2.2 *Ground Water*

The RI Report indicated that elevated levels of the TCE, 1,2-DCE, vinyl chloride, carbon tetrachloride, benzene, chlorobenzene, and tetrachloroethene (PCE) were detected in monitoring wells in the Runway Area. TCE and 1,2 DCE were commonly detected in ground water samples collected during the SSI sampling event. Sporadic detections of low estimated (i.e., "J" qualified data) concentrations of carbon tetrachloride and chlorobenzene were observed and vinyl chloride was not detected in any samples collected from the Runway Area during the

SSI. TCE levels above the MCL were widespread in the Runway Area. Only two other VOCs were detected above MCLs: carbon tetrachloride and methylene chloride in well GF-315. A comparison of 1,2-DCE and TCE levels detected during the RI versus the SSI sampling events reveals the concentrations of both compounds have generally decreased over time.

3.1.3 *North Base Landfill*

3.1.3.1 *Soils*

No additional soil samples were collected in the North Base Landfill Area as part of the SSI. The RI Report indicated that soils sampled in the Fruehauf parking lot had minimal contamination, except for some pesticides.

3.1.3.2 *Ground Water*

The primary VOCs detected during the RI sampling event were TCE, 1,2-DCE and DEHP. Generally, the number of compounds and the concentrations were less in the SSI sampling event compared to the RI sampling event. Review of data collected from the additional wells installed in the vicinity of the North Base Landfill during the SSI indicated that the only organic constituent to exceed its MCL was TCE; it was reported at concentrations above the MCL in two samples collected from ERM-16I (sampling dates: 5 January 1995 and 16 May 1995). On both occasions, the reported concentration was 52 μg/l.

In addition to the newly installed monitoring wells, RFW-1 was sampled twice during the SSI. Reported TCE concentrations were 45 μg/l (13 March 1995) and 16 μg/l (19 May 1995). No organic constituents were detected above MCLs in the HIA wells located in this area (i.e., HIA-16, HIA-17, and HIA-18). Inorganic constituents (i.e., aluminum, iron, manganese) were consistently detected in the North Base Landfill monitoring wells, and appear to be generally indicative of background.

The detection of organic constituents in the bedrock aquifer during the RI suggested that there was the potential for chemical constituents to be drawn toward Middletown supply well MID-04. This prompted the installation of the sentinel well nests to monitor whether contaminants were being drawn to MID-04. DEHP was detected above its MCL in two sentinel well nests (ERM-7 and ERM-8). Carbon tetrachloride and dieldrin were detected only in well ERM-9S(SENT). The detection of carbon tetrachloride and dieldrin only in overburden well ERM-9(SENT), which is separated from the North Base Landfill by Union Street, suggests a separate source area other than the North Base Landfill.

Samples were also collected from 8 residential wells during the SSI (Appendix D, Figure D-10). Organic compounds were infrequently detected in these wells; constituents included acetone, methylene chloride, DEHP (all of which are common laboratory contaminants; USEPA, 1989), TCE, and several pesticides. Each of these constituents was found in only one well, with the exception of dieldrin, a pesticide, which was found in two of the eight samples. Inorganic constituents were also consistently found in all samples, and appear to be generally indicative of background or regional conditions.

3.1.4 *Susquehanna River*

3.1.4.1 *Surface Water*

During the RI, surface water was sampled at eight different locations along the storm drain outfalls to the Susquehanna River. The organics present included 1,2-DCE, TCE, and 4,4'-DDT. Four of the eight stations previously sampled during the RI were sampled during the SSI (Appendix D, Figure D-8). Note that this sampling represents a component of the quarterly monitoring of the Susquehanna River (surface water and sediment) required by the 1990 ROD for the Middletown Airfield NPL Site.

Results of surface water samples collected during the SSI indicated the following:

- Isolated concentrations of several VOCs were reported in both upstream and downstream samples; constituents included 2-butanone, acetone, chloroform, methylene chloride, and PCE. No TCE was detected at any of the four sampling locations in 7 rounds of sampling.
- Low levels (i.e., 0.01 μg/l or less) of four pesticides (i.e., alpha chlordane, DDD, gamma BHC, and gamma chlordane) were sporadically detected in both upstream and downstream samples.
- Several inorganic constituents (i.e., aluminum, barium, calcium, iron, magnesium, manganese, potassium, and sodium) were consistently detected in all samples. Other inorganics (e.g., lead, zinc) were detected less frequently in both upstream and downstream samples.

Mercury was positively reported in only two samples out of 28: once in the upstream sample (SR-SW-8), and once in a downstream location (SR-SW-6).

3.1.4.2 Sediment

Sediment data were collected from four locations in the Susquehanna River (i.e., one upstream and three downstream locations) over the course of 7 quarterly sampling events. These data indicated the presence of VOCs, pesticides, PAHs, PCBs, and inorganics in both the upstream and downstream samples. Chlorinated VOCs present included only chloroform, methylene chloride (both common laboratory contaminants; USEPA, 1989), and isolated detections of PCE.

In general, the organic compounds were detected in similar concentrations in both upstream and downstream samples. However, PAH compounds were generally found in higher concentrations in upstream samples (i.e., in samples from location SR-SED-8). Inorganic constituents (e.g., chromium, copper, lead, and zinc) were detected in higher concentrations in some of the downstream sediment samples, particularly from location SR-SED-5. SED-5 is located near a discharge point for Post Run, which carries stormwater collected from the Site, as well as discharge from the wastewater treatment plant and other industrial and commercial areas.

3.1.5 Meade Heights

3.1.5.1 Surface Water

Two surface water samples were collected during the RI; no organics were detected and only zinc exceeded Ambient Water Quality Criteria (AWQC). During the SSI, four surface water samples were collected from the Meade Heights stream (Appendix D, Figure D-8). No organic constituents were positively detected. (Note - acetone was reported in three locations, but the result was qualitatively invalid due to similar concentrations in a blank). Inorganic constituents were detected in all samples, at levels generally consistent with the concentrations found in the upstream sample.

3.1.5.2 Sediment

Two sediment samples were collected from the Meade Heights stream during the RI. The organic chemicals detected were DEHP and methylene chloride. No pesticides were detected, and inorganics were not present at levels of concern.

Constituents detected in Meade Heights sediment samples collected during the SSI included several VOCs, PAHs, and inorganics. Three of the five VOC compounds detected are common laboratory contaminants (i.e., 2-butanone, acetone, and methylene chloride; USEPA, 1989). In addition to these compounds, carbon disulfide and TCE were each detected in a single location.

3.1.6 Radiological Survey

3.1.6.1 Ground Water

Ground water samples were analyzed by EPA Method 903.1 for radium-226. The analytical results indicated the minimum detectable activity (MDA) for the method was approximately 1 pCi/l. The quality control sample results were acceptable for the spike and blank samples. None of the ground water samples contained radium-226 at levels in excess of the MDA. Since radium-226 was not detected in these samples, it was not considered to be of concern in ground water. These data were not evaluated further in the BRA.

3.1.6.2 Wipe Samples

Two wipe samples were collected from a background vault and from two other storm sewer vaults; selection of the vaults was based on the radiological instrument survey using a "Micro R Meter." Each wipe covered approximately 150 square inches (approximately 70 square inches on each of two walls of the vault). These six samples were each put into solution by acid digestion of the entire wipe, and the solutions were analyzed by EPA Method 903.1 for radium-226.

Analysis of Wipe Samples

Based on the analytical results, the MDA for the method was approximately 0.04 pCi per wipe sample. All but one of the samples exceeded the MDA, indicating that radium-226 was detected on each of these samples.

Wipe samples STSD-RAD1 and STSD-RAD2 were taken as background wipes from a vault on a storm sewer line not connected to Building 135 (Appendix D, Figure D-7A). The results from these samples were 0.136

+/- 0.019 pCi and 0.099 +/- 0.017 pCi (uncertainties, shown as +/-, represent 1 standard deviation or 1 sigma). These were compared to the result obtained from an unused wipe analyzed as a media blank, for which the measured radium-226 content was estimated at 0.002 +/- 0.022 pCi (i.e., significantly less than the detection limit of about 0.04 pCi). Thus, the concentrations in the background wipes exceeded the concentration in the blank, indicating that these were analytically valid results.

Wipe samples STSD-RAD5 and STSD-RAD6 were taken from the K-4 vault, the first vault downgradient of Building 135. Wipe sample STSD-RAD6 did not contain radium-226 above the MDA (the value was estimated at 0.012 +/- 0.015 pCi, and the MDA was estimated to be about 0.053 pCi). Wipe sample STSD-RAD5 was used for quality assurance and data evaluation. An original and three replicate samples were taken, resulting in four analytical values. The four wipes were obtained from adjacent areas on the two vault walls (that is, the same areas on the vault walls were not wiped four times). The results were 0.043 +/- 0.013, 0.061 +/- 0.016, 0.081 +/- 0.017, and 1.501 +/- 0.056 pCi (all with MDAs of about 0.04 pCi), illustrating the variability of these sampling and analysis techniques.

Wipe samples STSD-RAD3 and STSD-RAD4 were taken from the K-3 vault, the second vault downgradient of Building 135. The results for these two wipe samples were 0.674 +/- 0.037 pCi and 0.346 +/- 0.027 pCi, respectively (again, with MDAs of about 0.04 pCi).

Relevant guidance to which the wipe sample results may be compared include the surface contamination limits provided in the NRC Regulatory Guide 1.86. The removable surface contamination limit for radium-226 is 20 dpm/100 cm^2. Converting the highest wipe sample results given above (1.501 pCi; STSD-RAD5) to these units gives 0.344 dpm/100 cm^2, which is less than 2 percent of the limit. Thus, the reported results do not appear to be a concern.

Because this review indicated that the detected levels well below applicable guidelines, and because of the limited opportunity for exposure to the vault interiors, no further evaluation of these data was included in the BRA.

3.1.7 *Smith Data*

On behalf of PennDot, Smith Environmental Technologies Corporation performed a parallel study to the SSI. As part of that investigation, soil samples were collected from a maximum depth of 5 feet in the Industrial Area, the Lagoons, the Runway Area, the Warehouse Area, and the Penn State Campus. Results of this sampling indicated similar results to the data collected during the SSI. That is, the primary constituents detected were the PAHs and the inorganics, and the concentrations of both the PAHs and the inorganic constituents reported in the data collected by Smith were generally similar to concentrations reported in the SSI for the Industrial Area. VOCs were detected very infrequently. At the request of USEPA, these data have been included in the BRA.

3.2 *HUMAN HEALTH SCREENING EVALUATION*

The human health screening evaluation was performed by medium, considering soil, ground water, and surface water/sediment. For each medium, the evaluation addressed the following:

- Potential exposure pathways associated with the medium were described;
- The screening criteria to be used in the evaluation were identified; and
- The results of the screening were discussed.

The following text describes the human health evaluations for soil, ground water, surface water/sediment in the Susquehanna River, and surface water/sediment in Meade Heights. Detailed tables summarizing the results of each screening step are presented in Appendix F.

3.2.1 *Soil*

The primary potential exposure pathways associated with soil include:

- Direct contact (i.e., incidental ingestion and dermal contact) with surface soil; and
- Leaching of soil constituents to ground water.

Institutional controls, implemented as part of the 1990 ROD, prohibit any construction or excavation activities without prior approval from

PennDOT and the Pennsylvania Department of Environmental Protection (PADEP). Thus, there are not expected to be uncontrolled direct exposures to subsurface soils.

As discussed below, other potential exposure pathways are not expected to contribute significantly to the total risk.

- Potential storm water runoff may result in the transport of surface soil constituents to surface water. However, since storm water is collected by a system of on-site sewers, this pathway is not expected to represent a significant exposure. (Note - as discussed in Section 3.1, the storm sewers will be addressed as part of the ongoing storm sewer discharge permitting process).

- Occasional flooding of portions of the Runway Area and the Industrial Area may have resulted in the transport of soil constituents to the Susquehanna River in the past. However, under current conditions, the implementation of flood control measures at the Site is expected to significantly limit any potential constituent migration via this pathway. (Note that the flood control measures are required to ensure that airport operations can continue, even during heavy storm events). The effects of past flooding of the Site on the Susquehanna River were considered via the evaluation of surface water and sediment data collected from the River during the SSI (Section 3.2.3 and Section 3.3.2).

- Fugitive dust may be released from surface soils when they are disturbed. However, this is not expected to result in significant exposures at this Site because the majority of the Site is paved or vegetated. Institutional controls prevent excavation or construction activities without prior approval from PennDOT and PADEP. Thus, there are not expected to be uncontrolled exposures to fugitive dust during construction.

- Volatile compounds may also be released from soils. However, this is not expected to be a significant pathway for this Site, in light of the limited detections of VOCs.

Based on the pathways discussion presented above, this screening assessment for soils focused on the direct contact and leaching pathways. Each of these pathways was assessed separately, as discussed below.

3.2.1.1 *Direct Contact*

The direct contact pathway was evaluated by comparing surface soil data (i.e., 0 - 2 foot interval) to Region III Industrial RBCs (USEPA, 1995a), as described below:

- A ratio of the maximum constituent concentration to its RBC was calculated for each constituent and endpoint (i.e., carcinogenic and noncarcinogenic endpoints).
- From these ratios, a total carcinogenic risk and a noncarcinogenic hazard index were calculated for a worker, based on the sum of the calculated ratios for each endpoint.
- The total risk and the hazard index were then compared to acceptable risk levels defined by USEPA.

As shown on Tables 3-1 and 3-2, cumulative risks were calculated for each area sampled by ERM during the SSI, as well as each area sampled by Smith. This analysis was performed using the maximum detected concentration of each carcinogenic constituent. The results of this conservative analysis indicated that the cumulative risks estimated for each area are within the range of acceptable risk defined by USEPA (i.e., 1 x 10^{-4} to 1 x 10^{-6}; a risk estimate of 1 x 10^{-6} indicates that there is a probability of one in one million of a cancer occurring during a person's lifetime as a result of the defined exposure). Thus, based on this analysis, no unacceptable levels of carcinogenic risk were found to be associated with soils at any of the areas sampled (i.e., in the Industrial Areas sampled in the SSI or by Smith or in the background location). [Note - for the remaining discussion in the Human Health Evaluation, Industrial Areas refers to the active Industrial Area, including the pipelines; the Lagoon Area; the North Base Landfill; the Penn State Area; the Runway Area; the Terminal Area; and the Warehouse Area].

A similar analysis was performed to evaluate noncarcinogenic hazard. As shown on Table 3-3, noncarcinogenic hazard indices are equal to or less than one for all areas where soil samples were collected in the SSI. A hazard index of one or less than one indicates that no adverse health effects are anticipated as a result of the defined conditions of exposure. The results of this analysis for the Smith data yielded a similar conclusion (Table 3-4), with the exception of the Terminal Area. In this area, soil samples were collected beneath the parking lot and in the grassed berms around the parking areas. For these samples, the estimated hazard index was 2, and the largest component of this value was associated with

Table 3-1
ERM Data
Cumulative Risks for Soil Samples
Carcinogenic Constituents
By Sampling Area
Middletown Airfield NPL Site
Middletown, Pennsylvania

Sample Name	Parameter	Maximum	Qualifier	Collection Date	Screening Level	Risk Level
BK-SB44(SSC)	Arsenic	10.50		8/4/94	3.80	2.76E-06
BK-SB44(SSC)	Benzo(a)anthracene	1000.00		8/4/94	7800.00	1.28E-07
BK-SB44(SSC)	Benzo(a)pyrene	1100.00		8/4/94	780.00	1.41E-06
BK-SB44(0.2-0.5)	Benzo(b)fluoranthene	2300.00	H	8/4/94	7800.00	2.95E-07
BK-SB46(SSC)	Beryllium	2.40		8/4/94	1.30	1.85E-06
BK-SB47(SSC)	bis(2-Ethylhexyl)phthalate	300.00	J	8/5/94	410000.00	7.32E-10
BK-SB44(SSC)	Chrysene	1300.00		8/4/94	780000.00	1.67E-09
BK-SB46(SSC)	DDE	6.00	J	8/4/94	17000.00	3.53E-10
BK-SB46(SSC)	DDT	10.00	J	8/4/94	17000.00	5.88E-10
BK-SB43(0.2-0.5)	Dibenz(a,h)anthracene	310.00	J	8/4/94	780.00	3.97E-07
BK-SB52(SSC)	Dieldrin	239.00		8/5/94	360.00	6.64E-07
BK-SB43(0.2-0.5)	Indeno(1,2,3-cd)pyrene	1600.00		8/4/94	7800.00	2.05E-07
					Cumulative Sum:	8E-06
ERM-1S(0.5-2.0)	Arsenic	9.10		6/6/94	3.80	2.39E-06
ERM-1S(SSC)	Benzo(a)anthracene	1500.00		6/6/94	7800.00	1.92E-07
ERM-1S(SSC)	Benzo(a)pyrene	1300.00		6/6/94	780.00	1.67E-06
ERM-1S(SSC)	Benzo(b)fluoranthene	2100.00		6/6/94	7800.00	2.69E-07
ERM-1SA(0.5-2.0)	Beryllium	0.59		6/6/94	1.30	4.54E-07
ERM-1S(SSC)	bis(2-Ethylhexyl)phthalate	260.00	J	6/6/94	410000.00	6.34E-10
ERM-1S(SSC)	Carbazole	55.00	J	6/6/94	290000.00	1.90E-10
ERM-1S(SSC)	Chrysene	1800.00		6/6/94	780000.00	2.31E-09
ERM-1S(SSC)	DDE	30.00		6/6/94	17000.00	1.76E-09
ERM-1S(SSC)	DDT	60.00		6/6/94	17000.00	3.53E-09
ERM-1S(SSC)	Dieldrin	120.00		6/6/94	360.00	3.33E-07
ERM-1S(SSC)	Indeno(1,2,3-cd)pyrene	860.00		6/6/94	7800.00	1.10E-07
					Cumulative Sum:	5E-06

Table 3-1
ERM Data
Cumulative Risks for Soil Samples
Carcinogenic Constituents
By Sampling Area
Middletown Airfield NPL Site
Middletown, Pennsylvania

Sample Name	Parameter	Maximum	Qualifier	Collection Date	Screening Level	Risk Level
IAB-SB31(0.5-2.5)	1,4-Dichlorobenzene	200.00	J	6/14/94	240000.00	8.33E-10
IAB-SB20(0.5-2.5)	Aldrin	10.00		6/2/94	340.00	2.94E-08
IAB-SB30(SSC)	Arsenic	11.60	J	6/14/94	3.80	3.05E-06
IAB-SB35(SSC)	Benzo(a)anthracene	4900.00		6/15/94	7800.00	6.28E-07
IAB-SB34(SSC)	Benzo(a)pyrene	4200.00		6/15/94	780.00	5.38E-06
IAB-SB35(SSC)	Benzo(b)fluoranthene	7600.00		6/15/94	7800.00	9.74E-07
IAB-SB16(SSC)	Beryllium	0.81		6/1/94	1.30	6.23E-07
IAB-SB20(SSC)	bis(2-Ethylhexyl)phthalate	3600.00		6/2/94	410000.00	8.78E-09
IAB-SB35(SSC)	Carbazole	1500.00		6/15/94	290000.00	5.17E-09
IAB-SB35(SSC)	Chrysene	5200.00		6/15/94	780000.00	6.67E-09
IAB-SB15(SSC)	DDD	10.00	J	5/31/94	24000.00	4.17E-10
IAB-SB31(SSC)	DDE	120.00		6/14/94	17000.00	7.06E-09
IAB-SB16(SSC)	DDT	130.00		6/1/94	17000.00	7.65E-09
IAB-SB34(SSC)	Dibenz(a,h)anthracene	1300.00		6/15/94	780.00	1.67E-06
IAB-SB35(SSC)	Dieldrin	810.00		6/15/94	360.00	2.25E-06
IAB-SB34(SSC)	Indeno(1,2,3-cd)pyrene	5100.00		6/15/94	7800.00	6.54E-07
IAB-SB31(0.5-2.5)	Tetrachloroethene	40.00		6/14/94	110000.00	3.64E-10
IAB-SB31(0.5-2.5)	Trichloroethene	3.10	J	6/14/94	520000.00	5.96E-12
					Cumulative Sum:	2E-05
IAL-SB11(0.5-2.5)	Arsenic	7.40		8/3/94	3.80	1.95E-06
IAL-SB12(SSC)	Benzo(a)anthracene	1500.00		8/3/94	7800.00	1.92E-07
IAL-SB12(SSC)	Benzo(a)pyrene	1800.00		8/3/94	780.00	2.31E-06
IAL-SB12(SSC)	Benzo(b)fluoranthene	3100.00	H	8/3/94	7800.00	3.97E-07
IAL-SB11(SSC)	Beryllium	0.57		8/3/94	1.30	4.38E-07
IAL-SB12(SSC)	bis(2-Ethylhexyl)phthalate	18000.00		8/3/94	410000.00	4.39E-08
IAL-SB12(SSC)	Carbazole	100.00	J	8/3/94	290000.00	3.45E-10
IAL-SB12(SSC)	Chrysene	1800.00		8/3/94	780000.00	2.31E-09

Table 3-1
ERM Data
Cumulative Risks for Soil Samples
Carcinogenic Constituents
By Sampling Area
Middletown Airfield NPL Site
Middletown, Pennsylvania

Sample Name	Parameter	Maximum	Qualifier	Collection Date	Screening Level	Risk Level
IAL-SB12(SSC)	DDD	7.00	J	8/3/94	24000.00	2.92E-10
IAL-SB12(SSC)	DDE	20.00		8/3/94	17000.00	1.18E-09
IAL-SB12(SSC)	DDT	40.00		8/3/94	17000.00	2.35E-09
IAL-SB12(SSC)	Dibenz(a,h)anthracene	350.00	J	8/3/94	780.00	4.49E-07
IAL-SB12(SSC)	Dieldrin	150.00		8/3/94	360.00	4.17E-07
IAL-SB12(SSC)	Indeno(1,2,3-cd)pyrene	1300.00		8/3/94	7800.00	1.67E-07
					Cumulative Sum:	6E-06
IAP-SB2(SSC)	Arsenic	8.30	J	8/1/94	3.80	2.18E-06
IAP-SB2(SSC)	Benzo(a)anthracene	1500.00		8/1/94	7800.00	1.92E-07
IAP-SB2(SSC)	Benzo(a)pyrene	1600.00		8/1/94	780.00	2.05E-06
IAP-ERM2S(SSC)	Benzo(b)fluoranthene	3100.00	H	8/8/94	7800.00	3.97E-07
IAP-ERM2S(SSC)	Beryllium	0.64		8/8/94	1.30	4.92E-07
IAP-ERM2S(SSC)	bis(2-Ethylhexyl)phthalate	320.00	J	8/8/94	410000.00	7.80E-10
IAP-ERM2S(SSC)	Carbazole	220.00	J	8/8/94	290000.00	7.59E-10
IAP-SB2(SSC)	Chrysene	1600.00		8/1/94	780000.00	2.05E-09
IAP-ERM2S(SSC)	DDE	20.00		8/8/94	17000.00	1.18E-09
IAP-ERM2S(SSC)	DDT	20.00		8/8/94	17000.00	1.18E-09
IAP-SB2(SSC)	Dibenz(a,h)anthracene	300.00	J	8/1/94	780.00	3.85E-07
IAP-SB2(SSC)	Dieldrin	50.00		8/1/94	360.00	1.39E-07
IAP-SB2(SSC)	Indeno(1,2,3-cd)pyrene	1100.00		8/1/94	7800.00	1.41E-07
					Cumulative Sum:	6E-06

Table 3-1
ERM Data
Cumulative Risks for Soil Samples
Carcinogenic Constituents
By Sampling Area
Middletown Airfield NPL Site
Middletown, Pennsylvania

Sample Name	Parameter	Maximum	Qualifier	Collection Date	Screening Level	Risk Level
MH-GS2(0.0-2.0)	Arsenic	4.70		7/18/95	3.80	1.24E-06
MH-GS2(0.0-2.0)	Beryllium	0.80	J	7/18/95	1.30	6.15E-07
MH-GS2A(0.0-2.0)	bis(2-Ethylhexyl)phthalate	480.00		7/18/95	410000.00	1.17E-09
MH-GS8(0.0-2.0)	Methylene Chloride	6.00	J	7/17/95	760000.00	7.89E-12
					Cumulative Sum:	2E-06
RA-SB53(0.0-2.0)	Arsenic	4.10		8/17/94	3.80	1.08E-06
RA-SB53(0.0-2.0)	Beryllium	0.66		8/17/94	1.30	5.08E-07
RA-SB53(0.0-2.0)	Dieldrin	4.00	J	8/17/94	360.00	1.11E-08
					Cumulative Sum:	2E-06

Note:
All data and their respective screening levels are in the same units. Organics are in µg/kg and inorganics are in mg/kg.

Table 3-2
Smith Data
Cumulative Risks for Soil Samples
for Carcinogenic Constituents by Sampling Area
Middletown Air Field
Middletown, Pennsylvania

Sample Name	Parameter	Maximum	Qualifier	Collection Date	Screening Level	Risk Level
IA-026-B-E1'	3,3'-Dichlorobenzidine	120.00 Jn		1/9/95	13000.00	9.23E-09
IA-023-B-E1'	Aldrin	1.50 Jj		1/12/95	340.00	4.41E-09
IA-027-B-E1'	Alpha BHC	0.65 Jj		1/12/95	910.00	7.14E-10
IA-018-B-E1'	Alpha Chlordane	7.30 j		1/9/95	4400.00	1.66E-09
IA-026-B-I1-5'	Arsenic	14.80 j		1/9/95	3.80	3.89E-06
IA-020-B-ED1'	Benzo(a)anthracene	1100.00 j		1/9/95	7800.00	1.41E-07
IA-020-B-ED1'	Benzo(a)pyrene	1400.00 j		1/9/95	780.00	1.79E-06
IA-020-B-ED1'	Benzo(b)fluoranthene	2600.00 j		1/9/95	7800.00	3.33E-07
IA-020-B-ED1'	Benzo(k)fluoranthene	950.00 j		1/9/95	78000.00	1.22E-08
IA-001-B-I1.5-5'	Beryllium	1.56		1/13/95	1.30	1.20E-06
IA-020-B-ED1'	Carbazole	110.00 Jj		1/9/95	290000.00	3.79E-10
IA-020-B-ED1'	Chrysene	1400.00 j		1/9/95	780000.00	1.79E-09
IA-026-B-E1'	DDD	28.00 Jj		1/9/95	24000.00	1.17E-09
IA-026-B-E1'	DDE	59.00 Jj		1/9/95	17000.00	3.47E-09
IA-026-B-E1'	DDT	220.00 j		1/9/95	17000.00	1.29E-08
IA-020-B-ED1'	Dibenz(a,h)anthracene	330.00 Jj		1/9/95	780.00	4.23E-07
IA-026-B-E1'	Dieldrin	56.00 Jj		1/9/95	360.00	1.56E-07
IA-005-B-E1'	Gamma BHC - Lindane	0.54 Jj		1/10/95	4400.00	1.23E-10
IA-018-B-E1'	Gamma Chlordane	5.00 j		1/9/95	4400.00	1.14E-09
IA-023-B-E1'	Heptachlor	0.85 Jj		1/12/95	1300.00	6.54E-10
IA-018-B-E1'	Heptachlor Epoxide	3.70 j		1/9/95	630.00	5.87E-09
IA-026-B-E1'	Indeno(1,2,3-cd)pyrene	1100.00		1/9/95	7800.00	1.41E-07
IA-026-B-E1'	PCB-1260	1500.00 j		1/9/95	740.00	2.03E-06
IA-026-B-E1'	Total PCB's	1500.00		1/9/95	740.00	2.03E-06
					Cumulative Sum:	1E-05
LA-016-B-E1'	1,4-Dichlorobenzene	180.00 Jj		11/10/94	240000.00	7.50E-10
LA-001-B-E1'	Aldrin	13.00 Jj		11/9/94	340.00	3.82E-08
LA-013-B-E1'	Alpha Chlordane	16.00 Jj		11/11/94	4400.00	3.64E-09
LA-015-B-I1-4'	Arsenic	14.20		11/10/94	3.80	3.74E-06
LA-006-B-E1'	Benzo(a)anthracene	5900.00		11/10/94	7800.00	7.56E-07
LA-006-B-E1'	Benzo(a)pyrene	5400.00		11/10/94	780.00	6.92E-06
LA-006-B-E1'	Benzo(b)fluoranthene	6100.00		11/10/94	7800.00	7.82E-07
LA-008-B-E1'	Benzo(k)fluoranthene	2300.00 Jj		11/9/94	78000.00	2.95E-08
LA-002-B-I1-5'	Beryllium	0.74 Jj		11/9/94	1.30	5.72E-07
LA-008-B-E1'	Carbazole	910.00 Jj		11/9/94	290000.00	3.14E-09
LA-006-B-E1'	Chrysene	5900.00		11/10/94	780000.00	7.56E-09
LA-011-B-E1'	DDD	90.00 Jj		11/10/94	24000.00	3.75E-09
LA-013-B-E1'	DDE	900.00 j		11/11/94	17000.00	5.29E-08
LA-011-B-E1'	DDT	4200.00 j		11/10/94	17000.00	2.47E-07
LA-005-B-E1'	Dibenz(a,h)anthracene	910.00 Jj		11/10/94	780.00	1.17E-06
LA-014-B-E1'	Dieldrin	160.00 j		11/10/94	360.00	4.44E-07
LA-016-B-E1'	Gamma Chlordane	28.00 Jl		11/10/94	4400.00	6.36E-09
LA-013-B-E1'	Heptachlor Epoxide	23.00 Jj		11/11/94	630.00	3.65E-08
LA-008-B-E1'	Indeno(1,2,3-cd)pyrene	2600.00 Jj		11/9/94	7800.00	3.33E-07
LA-013-B-ED1'	Isophorone	49.00 Jj		11/11/94	6000000.00	8.17E-12
LA-011-B-E1'	N-Nitroso-di-n-propylamine	270.00 Jj		11/10/94	820.00	3.29E-07
LA-016-B-E1'	Total PCB's	1100.00		11/10/94	740.00	1.49E-06
LA-016-B-E1'	bis(2-Ethylhexyl)phthalate	970.00 j		11/10/94	410000.00	2.37E-09
					Cumulative Sum:	2E-05
PS-014-B-E1'	Aldrin	1.00 Jj		1/12/95	340.00	2.94E-09
PS-016-B-E1'	Alpha Chlordane	5.50		1/12/95	4400.00	1.25E-09
PS-007-B-I1-5'	Arsenic	7.56 l		1/11/95	3.80	1.99E-06
PS-014-B-E1'	Benzo(a)anthracene	2300.00 j		1/12/95	7800.00	2.95E-07
PS-014-B-E1'	Benzo(a)pyrene	2600.00 j		1/12/95	780.00	3.33E-06
PS-014-B-E1'	Benzo(b)fluoranthene	3000.00 j		1/12/95	7800.00	3.85E-07
PS-014-B-E1'	Benzo(k)fluoranthene	1000.00 Jj		1/12/95	78000.00	1.28E-08

Table 3-2
Smith Data
Cumulative Risks for Soil Samples
for Carcinogenic Constituents by Sampling Area
Middletown Air Field
Middletown, Pennsylvania

Sample Name	Parameter	Maximum	Qualifier	Collection Date	Screening Level	Risk Level
PS-015-B-I1-5'	Beryllium	0.68	[]	1/12/95	1.30	5.25E-07
PS-014-B-E1'	Chrysene	3000.00	j	1/12/95	780000.00	3.85E-09
PS-015-B-E1'	DDD	3.60	Jj	1/12/95	24000.00	1.50E-10
PS-003-B-E1'	DDE	2.10	Jj	1/11/95	17000.00	1.24E-10
PS-015-B-E1'	DDT	19.00	j	1/12/95	17000.00	1.12E-09
PS-014-B-E1'	Dibenz(a,h)anthracene	550.00	Jj	1/12/95	780.00	7.05E-07
PS-002-B-E1'	Dieldrin	87.00	Dj	1/11/95	360.00	2.42E-07
PS-012-B-E1'	Gamma BHC - Lindane	0.72	Jj	1/11/95	4400.00	1.64E-10
PS-016-B-E1'	Gamma Chlordane	6.60		1/12/95	4400.00	1.50E-09
PS-014-B-E1'	Heptachlor	0.87	Jj	1/12/95	1300.00	6.69E-10
PS-016-B-E1'	Heptachlor Epoxide	2.80		1/12/95	630.00	4.44E-09
PS-014-B-E1'	Indeno(1,2,3-cd)pyrene	1500.00	j	1/12/95	7800.00	1.92E-07
					Cumulative Sum:	8E-06
RW-013-B-E1'	Aldrin	35.00	Jj	12/2/94	340.00	1.03E-07
RW-093-B-E1'	Alpha Chlordane	2.10	Jj	11/16/94	4400.00	4.77E-10
RW-052-B-I1-5'	Arsenic	18.30	1	11/30/94	3.80	4.82E-06
RW-071-B-E1'	Benzo(a)anthracene	45000.00		11/16/94	7800.00	5.77E-06
RW-071-B-E1'	Benzo(a)pyrene	31000.00		11/16/94	780.00	3.97E-05
RW-071-B-E1'	Benzo(b)fluoranthene	48000.00		11/16/94	7800.00	6.15E-06
RW-071-B-E1'	Benzo(k)fluoranthene	20000.00		11/16/94	78000.00	2.56E-07
RW-132-B-I1-5'	Beryllium	5.16		11/15/94	1.30	3.97E-06
RW-071-B-E1'	Carbazole	17000.00	Jj	11/16/94	290000.00	5.86E-08
RW-071-B-E1'	Chrysene	41000.00		11/16/94	780000.00	5.26E-08
RW-097-B-E1'	DDD	16.00	Jj	11/15/94	24000.00	6.67E-10
RW-095-B-E1'	DDE	32.00		12/6/94	17000.00	1.88E-09
RW-035-B-ED1'	DDT	13.00	k	12/20/94	17000.00	7.65E-10
RW-071-B-E1'	Dibenz(a,h)anthracene	5900.00	Jj	11/16/94	780.00	7.56E-06
RW-095-B-E1'	Dieldrin	430.00		12/6/94	360.00	1.19E-06
RW-003-B-E1'	Gamma BHC - Lindane	1.10	Jj	12/6/94	4400.00	2.50E-10
RW-085-B-E1'	Gamma Chlordane	1.60	Jj	11/16/94	4400.00	3.64E-10
RW-093-B-E1'	Heptachlor	3.80	Jj	11/16/94	1300.00	2.92E-09
RW-005-B-E1'	Heptachlor Epoxide	8.20	Jj	12/6/94	630.00	1.30E-08
RW-071-B-E1'	Indeno(1,2,3-cd)pyrene	18000.00		11/16/94	7800.00	2.31E-06
RW-080-B-E1'	N-Nitroso-di-n-propylamine	200.00	Jn	11/30/94	820.00	2.44E-07
RW-093-B-E1'	N-Nitrosodiphenylamine	120.00	Jn	11/16/94	1200000.00	1.00E-10
RW-013-B-E1'	PCB-1248	520.00	Jj	12/2/94	740.00	7.03E-07
RW-013-B-E1'	Total PCB's	520.00		12/2/94	740.00	7.03E-07
RW-092-B-E1'	bis(2-Ethylhexyl)phthalate	210.00	Jj	11/16/94	410000.00	5.12E-10
					Cumulative Sum:	7E-05
TA-034-B-E1'	Aldrin	34.00	j	1/24/95	340.00	1.00E-07
TA-006-B-E1'	Alpha BHC	0.21	Jj	1/23/95	910.00	2.31E-10
TA-049-B-E1'	Alpha Chlordane	95.00	Dj	1/19/95	4400.00	2.16E-08
TA-053-B-S-I1-5'	Arsenic	15.00		1/23/95	3.80	3.95E-06
TA-015-B-E1'	Benzo(a)anthracene	10000.00		1/19/95	7800.00	1.28E-06
TA-015-B-E1'	Benzo(a)pyrene	11000.00		1/19/95	780.00	1.41E-05
TA-015-B-E1'	Benzo(b)fluoranthene	12000.00		1/19/95	7800.00	1.54E-06
TA-015-B-E1'	Benzo(k)fluoranthene	3800.00		1/19/95	78000.00	4.87E-08
TA-002-B-I1-5'	Beryllium	1.85		1/25/95	1.30	1.42E-06
TA-049-B-E1'	Beta BHC	1.30	Jj	1/19/95	3200.00	4.06E-10
TA-051-B-E1'	Carbazole	310.00	Jj	1/18/95	290000.00	1.07E-09
TA-015-B-E1'	Chrysene	13000.00		1/19/95	780000.00	1.67E-08
TA-031-B-E1'	DDD	210.00	j	1/24/95	24000.00	8.75E-09
TA-034-B-E1'	DDE	510.00	j	1/24/95	17000.00	3.00E-08
TA-031-B-E1'	DDT	140.00		1/24/95	17000.00	8.24E-09
TA-015-B-E1'	Dibenz(a,h)anthracene	2200.00		1/19/95	780.00	2.82E-06
TA-031-B-E1'	Dieldrin	440.00	j	1/24/95	360.00	1.22E-06

Table 3-2
Smith Data
Cumulative Risks for Soil Samples
for Carcinogenic Constituents by Sampling Area
Middletown Air Field
Middletown, Pennsylvania

Sample Name	Parameter	Maximum	Qualifier	Collection Date	Screening Level	Risk Level
TA-002-B-E1'	Gamma BHC - Lindane	1.10	Jj	1/25/95	4400.00	2.50E-10
TA-049-B-E1'	Gamma Chlordane	85.00	D	1/19/95	4400.00	1.93E-08
TA-013-B-E1'	Heptachlor	0.35	Jj	1/17/95	1300.00	2.69E-10
TA-015-B-E1'	Heptachlor Epoxide	12.00	j	1/19/95	630.00	1.90E-08
TA-015-B-E1'	Indeno(1,2,3-cd)pyrene	5500.00		1/19/95	7800.00	7.05E-07
TA-042-B-E1'	PCB-1248	11.00	Jj	1/19/95	740.00	1.49E-08
TA-006-B-E1'	PCB-1260	1200.00	j	1/23/95	740.00	1.62E-06
TA-006-B-E1'	Total PCB's	1200.00		1/23/95	740.00	1.62E-06
TA-053-B-E1'	bis(2-Ethylhexyl)phthalate	510.00		1/23/95	410000.00	1.24E-09
					Cumulative Sum:	3E-05
WA-013-B-E(1')	Aldrin	31.00	j	7/6/94	340.00	9.12E-08
WA-012-B-E(1')	Alpha Chlordane	17.00	Jj	7/7/94	4400.00	3.86E-09
WA-023-B-I(1-4')	Arsenic	73.00	j	7/7/94	3.80	1.92E-05
WA-012-B-E(1')	Benzo(a)anthracene	19000.00	y	7/7/94	7800.00	2.44E-06
WA-012-B-E(1')	Benzo(a)pyrene	15000.00		7/7/94	780.00	1.92E-05
WA-012-B-E(1')	Benzo(b)fluoranthene	20000.00	y	7/7/94	7800.00	2.56E-06
WA-012-B-E(1')	Benzo(k)fluoranthene	7100.00		7/7/94	78000.00	9.10E-08
WA-007-B-I(1-5')	Beryllium	1.03	[]	7/6/94	1.30	7.92E-07
WA-012-B-E(1')	Carbazole	11000.00	j	7/7/94	290000.00	3.79E-08
WA-012-B-E(1')	Chrysene	18000.00	y	7/7/94	780000.00	2.31E-08
WA-037-B-E(1')	DDD	48.00	j	7/8/94	24000.00	2.00E-09
WA-035-B-E(1')	DDE	35.00	Jj	7/8/94	17000.00	2.06E-09
WA-037-B-E(1')	DDT	140.00	D	7/8/94	17000.00	8.24E-09
WA-012-B-E(1')	Dibenz(a,h)anthracene	2600.00		7/7/94	780.00	3.33E-06
WA-023-B-E(1')	Dieldrin	3.30	Jj	7/7/94	360.00	9.17E-09
WA-013-B-E(1')	Gamma Chlordane	11.00	Jj	7/6/94	4400.00	2.50E-09
WA-023-B-E(1')	Heptachlor	0.92	Jj	7/7/94	1300.00	7.08E-10
WA-013-B-E(1')	Heptachlor Epoxide	21.00	j	7/6/94	630.00	3.33E-08
WA-012-B-E(1')	Indeno(1,2,3-cd)pyrene	7900.00		7/7/94	7800.00	1.01E-06
WA-015-B-E(1')	Total PCB's	69.00		7/6/94	740.00	9.32E-08
WA-028-B-E(1')	bis(2-Ethylhexyl)phthalate	1700.00	Jj	7/8/94	410000.00	4.15E-09
					Cumulative Sum:	5E-05

Note:
All data and their respective screening levels are in the same units. Organics are in µg/kg and inorganics are in mg/kg.

Table 3-3
ERM Data
Hazard Indices for Soil Samples
Noncarcinogenic Constituents
By Sample Area
Middletown Airfield NPL Site
Middletown, Pennsylvania

Sample Name	Parameter	Maximum	Qualifier	Collection Date	Screening Level	Hazard Quotient
BK-SB46(SSC)	2-Methylnaphthalene	100.00	J	8/4/94	82000000.00	0.00
BK-SB44(SSC)	Acenaphthene	100.00	J	8/4/94	120000000.00	0.00
BK-SB44(SSC)	Acenaphthylene	110.00	J	8/4/94	82000000.00	0.00
BK-SB46(SSC)	Aluminum	21600.00		8/4/94	1000000.00	0.02
BK-SB46(SSC)	Amenable Cyanide (solid)	1.90		8/4/94	41000.00	0.00
BK-SB44(SSC)	Anthracene	240.00	J	8/4/94	610000000.00	0.00
BK-SB51(SSC)	Antimony	13.80		8/5/94	820.00	0.02
BK-SB44(SSC)	Arsenic	10.50		8/4/94	610.00	0.02
BK-SB46(SSC)	Barium	207.00		8/4/94	140000.00	0.00
BK-SB43(0.2-0.5)	Benzo(g,h,i)perylene	2100.00		8/4/94	61000000.00	0.00
BK-SB46(SSC)	Beryllium	2.40		8/4/94	10220.00	0.00
BK-SB47(SSC)	bis(2-Ethylhexyl)phthalate	300.00	J	8/5/94	40880000.00	0.00
BK-SB45(0.2-0.5)	Cadmium	1.80		8/4/94	1000.00	0.00
BK-SB46(SSC)	Chromium	53.60		8/4/94	10000.00	0.01
BK-SB46(0.2-0.5)	Cobalt	37.40		8/4/94	120000.00	0.00
BK-SB44(SSC)	Copper	64.10		8/4/94	82000.00	0.00
BK-SB46(SSC)	DDT	10.00	J	8/4/94	1022000.00	0.00
BK-SB52(SSC)	Dieldrin	239.00		8/5/94	102000.00	0.00
BK-SB44(SSC)	Endrin	7.00	J	8/4/94	610000.00	0.00
BK-SB44(SSC)	Fluoranthene	2200.00		8/4/94	82000000.00	0.00
BK-SB44(SSC)	Fluorene	190.00	J	8/4/94	82000000.00	0.00
BK-SB46(0.2-0.5)	Iron	27000.00		8/4/94	610000.00	0.04
BK-SB45(SSC)	Manganese	2330.00		8/4/94	10000.00	0.23
BK-SB43(SSC)	Mercury	0.38		8/4/94	610.00	0.00
BK-SB46(SSC)	Naphthalene	160.00	J	8/4/94	82000000.00	0.00

Table 3-3
ERM Data
Hazard Indices for Soil Samples
Noncarcinogenic Constituents
By Sample Area
Middletown Airfield NPL Site
Middletown, Pennsylvania

Sample Name	Parameter	Maximum	Qualifier	Collection Date	Screening Level	Hazard Quotient
BK-SB46(SSC)	Nickel	49.70		8/4/94	41000.00	0.00
BK-SB44(SSC)	Phenanthrene	1700.00		8/4/94	61000000.00	0.00
BK-SB44(SSC)	Pyrene	3600.00		8/4/94	61000000.00	0.00
BK-SB44(SSC)	Selenium	1.10		8/4/94	10000.00	0.00
BK-SB46(0.2-0.5)	Silver	1.40		8/4/94	10000.00	0.00
BK-SB43(SSC)	Thallium	0.13	J	8/4/94	160.00	0.00
BK-SB46(SSC)	Total Cyanide (solid)	1.90		8/4/94	41000.00	0.00
BK-SB46(SSC)	Vanadium	23.60		8/4/94	14000.00	0.00
BK-SB46(SSC)	Zinc	212.00		8/4/94	610000.00	0.00
					Hazard Index	0.4
ERM-1S(SSC)	2-Methylnaphthalene	78.00	J	6/6/94	82000000.00	0.00
ERM-1S(SSC)	Acenaphthene	110.00	J	6/6/94	120000000.00	0.00
ERM-1S(SSC)	Acenaphthylene	190.00	J	6/6/94	82000000.00	0.00
ERM-1SA(0.5-2.0)	Aluminum	15200.00		6/6/94	1000000.00	0.02
ERM-1S(SSC)	Anthracene	310.00	J	6/6/94	610000000.00	0.00
ERM-1S(0.5-2.0)	Arsenic	9.10		6/6/94	610.00	0.01
ERM-1S(SSC)	Barium	62.50		6/6/94	140000.00	0.00
ERM-1S(SSC)	Benzo(g,h,i)perylene	930.00		6/6/94	61000000.00	0.00
ERM-1SA(0.5-2.0)	Beryllium	0.59		6/6/94	10220.00	0.00
ERM-1S(SSC)	bis(2-Ethylhexyl)phthalate	260.00	J	6/6/94	40880000.00	0.00
ERM-1S(SSC)	Cadmium	3.80		6/6/94	1000.00	0.00
ERM-1SA(0.5-2.0)	Chromium	17.10		6/6/94	10000.00	0.00
ERM-1SA(0.5-2.0)	Cobalt	11.70		6/6/94	120000.00	0.00

Table 3-3
ERM Data
Hazard Indices for Soil Samples
Noncarcinogenic Constituents
By Sample Area
Middletown Airfield NPL Site
Middletown, Pennsylvania

Sample Name	Parameter	Maximum	Qualifier	Collection Date	Screening Level	Hazard Quotient
ERM-1S(SSC)	Copper	23.30		6/6/94	82000.00	0.00
ERM-1S(SSC)	DDT	60.00		6/6/94	1022000.00	0.00
ERM-1S(SSC)	Dibenzofuran	52.00	J	6/6/94	8200000.00	0.00
ERM-1S(SSC)	Dieldrin	120.00		6/6/94	102000.00	0.00
ERM-1S(SSC)	Fluoranthene	2700.00		6/6/94	82000000.00	0.00
ERM-1S(SSC)	Fluorene	300.00	J	6/6/94	82000000.00	0.00
ERM-1SA(0.5-2.0)	Iron	27900.00		6/6/94	610000.00	0.05
ERM-1S(0.5-2.0)	Manganese	569.00		6/6/94	10000.00	0.06
ERM-1S(SSC)	Naphthalene	50.00	J	6/6/94	82000000.00	0.00
ERM-1S(0.5-2.0)	Nickel	20.00		6/6/94	41000.00	0.00
ERM-1S(SSC)	Phenanthrene	2100.00		6/6/94	61000000.00	0.00
ERM-1S(SSC)	Pyrene	4000.00		6/6/94	61000000.00	0.00
ERM-1S(SSC)	Silver	0.57	J	6/6/94	10000.00	0.00
ERM-1SA(0.5-2.0)	Thallium	0.13		6/6/94	160.00	0.00
ERM-1S(SSC)	Total Cyanide (solid)	0.20		6/6/94	41000.00	0.00
ERM-1S(SSC)	Vanadium	25.40		6/6/94	14000.00	0.00
ERM-1S(SSC)	Zinc	123.00		6/6/94	610000.00	0.00
					Hazard Index	0.1
IAB-SB31(0.5-2.5)	1,2,4-Trichlorobenzene	350.00	J	6/14/94	20000000.00	0.00
IAB-SB31(0.5-2.5)	1,2-Dichlorobenzene	390.00	J	6/14/94	180000000.00	0.00
IAB-SB31(0.5-2.5)	1,3-Dichlorobenzene	60.00	J	6/14/94	180000000.00	0.00
IAB-SB35(SSC)	2-Methylnaphthalene	180.00	J	6/15/94	82000000.00	0.00
IAB-SB35(SSC)	Acenaphthene	920.00		6/15/94	120000000.00	0.00

Table 3-3
ERM Data
Hazard Indices for Soil Samples
Noncarcinogenic Constituents
By Sample Area
Middletown Airfield NPL Site
Middletown, Pennsylvania

Sample Name	Parameter	Maximum	Qualifier	Collection Date	Screening Level	Hazard Quotient
IAB-SB34(SSC)	Acenaphthylene	500.00	J	6/15/94	82000000.00	0.00
IAB-SB30(0.5-2.5)	Acetone	2.80	J	6/14/94	200000000.00	0.00
IAB-SB20(0.5-2.5)	Aldrin	10.00		6/2/94	61000.00	0.00
IAB-SB20(0.5-2.5)	Aluminum	12800.00		6/2/94	1000000.00	0.01
IAB-SB20(SSC)	Amenable Cyanide (solid)	0.70		6/2/94	41000.00	0.00
IAB-SB35(SSC)	Anthracene	1700.00		6/15/94	610000000.00	0.00
IAB-SB16(SSC)	Antimony	11.10		6/1/94	820.00	0.01
IAB-SB30(SSC)	Arsenic	11.60	J	6/14/94	610.00	0.02
IAB-SB30(SSC)	Barium	128.00		6/14/94	140000.00	0.00
IAB-SB34(SSC)	Benzo(g,h,i)perylene	5300.00		6/15/94	61000000.00	0.00
IAB-SB16(SSC)	Beryllium	0.81		6/1/94	10220.00	0.00
IAB-SB20(SSC)	bis(2-Ethylhexyl)phthalate	3600.00		6/2/94	40880000.00	0.00
IAB-SB29(SSC)	Butylbenzylphthalate	82.00	J	6/13/94	410000000.00	0.00
IAB-SB18(SSC)	Cadmium	2.70		6/2/94	1000.00	0.00
IAB-SB31(0.5-2.5)	Carbon Disulfide	3.70	J	6/14/94	200000000.00	0.00
IAB-SB20(0.5-2.5)	Chromium	203.00		6/2/94	10000.00	0.02
IAB-SB13(0.5-2.5)	Cobalt	9.70		5/31/94	120000.00	0.00
IAB-SB18(SSC)	Copper	36.50		6/2/94	82000.00	0.00
IAB-SB16(SSC)	DDT	130.00		6/1/94	1022000.00	0.00
IAB-SB35(SSC)	Dibenzofuran	680.00		6/15/94	8200000.00	0.00
IAB-SB35(SSC)	Dieldrin	810.00		6/15/94	102000.00	0.01
IAB-SB35(SSC)	Endosulfan I	6.00	J	6/15/94	12000000.00	0.00
IAB-SB14(SSC)	Endosulfan II	20.00		5/31/94	12000000.00	0.00
IAB-SB34(SSC)	Endrin	20.00		6/15/94	610000.00	0.00
IAB-SB35(SSC)	Fluoranthene	12000.00		6/15/94	82000000.00	0.00

Table 3-3
ERM Data
Hazard Indices for Soil Samples
Noncarcinogenic Constituents
By Sample Area
Middletown Airfield NPL Site
Middletown, Pennsylvania

Sample Name	Parameter	Maximum	Qualifier	Collection Date	Screening Level	Hazard Quotient
IAB-SB35(SSC)	Fluorene	1100.00		6/15/94	82000000.00	0.00
IAB-SB13(0.5-2.5)	Iron	22600.00		5/31/94	610000.00	0.04
IAB-SB20(0.5-2.5)	Manganese	2250.00		6/2/94	10000.00	0.23
IAB-SB17(SSC)	Mercury	1.40		6/2/94	610.00	0.00
IAB-SB14(SSC)	Methoxychlor	80.00		5/31/94	10000000.00	0.00
IAB-SB18(SSC)	Naphthalene	220.00	J	6/2/94	82000000.00	0.00
IAB-SB14(SSC)	Nickel	24.40		5/31/94	41000.00	0.00
IAB-SB13(0.5-2.5)	PCB-1254	70.00	J	5/31/94	41000.00	0.00
IAB-SB35(SSC)	Phenanthrene	10000.00		6/15/94	61000000.00	0.00
IAB-SB35(SSC)	Pyrene	11000.00		6/15/94	61000000.00	0.00
IAB-SB30(SSC)	Selenium	2.50	J	6/14/94	10000.00	0.00
IAB-SB35(SSC)	Silver	10.90		6/15/94	10000.00	0.00
IAB-SB31(0.5-2.5)	Tetrachloroethene	40.00		6/14/94	20440000.00	0.00
IAB-SB15(SSC)	Thallium	0.67	J	5/31/94	160.00	0.00
IAB-SB18(SSC)	Total Cyanide (solid)	0.20		6/2/94	41000.00	0.00
IAB-SB31(0.5-2.5)	Trichloroethene	3.10	J	6/14/94	12264000.00	0.00
IAB-SB20(0.5-2.5)	Vanadium	44.90		6/2/94	14000.00	0.00
IAB-SB18(SSC)	Zinc	221.00		6/2/94	610000.00	0.00
					Hazard Index	0.4
IAL-SB11(SSC)	2-Methylnaphthalene	68.00	J	8/3/94	82000000.00	0.00
IAL-SB12(SSC)	Acenaphthene	97.00	J	8/3/94	120000000.00	0.00
IAL-SB12(SSC)	Acenaphthylene	360.00	J	8/3/94	82000000.00	0.00
IAL-SB11(SSC)	Aluminum	11200.00		8/3/94	1000000.00	0.01

Table 3-3
ERM Data
Hazard Indices for Soil Samples
Noncarcinogenic Constituents
By Sample Area
Middletown Airfield NPL Site
Middletown, Pennsylvania

Sample Name	Parameter	Maximum	Qualifier	Collection Date	Screening Level	Hazard Quotient
IAL-SB11(SSC)	Amenable Cyanide (solid)	0.10	J	8/3/94	41000.00	0.00
IAL-SB12(SSC)	Anthracene	250.00	J	8/3/94	610000000.00	0.00
IAL-SB11(SSC)	Antimony	9.80		8/3/94	820.00	0.01
IAL-SB11(0.5-2.5)	Arsenic	7.40		8/3/94	610.00	0.01
IAL-SB11(0.5-2.5)	Barium	69.20		8/3/94	140000.00	0.00
IAL-SB12(SSC)	Benzo(g,h,i)perylene	1300.00		8/3/94	61000000.00	0.00
IAL-SB11(SSC)	Beryllium	0.57		8/3/94	10220.00	0.00
IAL-SB12(SSC)	bis(2-Ethylhexyl)phthalate	18000.00		8/3/94	40880000.00	0.00
IAL-SB12(SSC)	Butylbenzylphthalate	42.00	J	8/3/94	410000000.00	0.00
IAL-SB11(SSC)	Cadmium	62.40		8/3/94	1000.00	0.06
IAL-SB11(0.5-2.5)	Chromium	57.50		8/3/94	10000.00	0.01
IAL-SB11(SSC)	Cobalt	9.30		8/3/94	120000.00	0.00
IAL-SB11(SSC)	Copper	76.60		8/3/94	82000.00	0.00
IAL-SB12(SSC)	DDT	40.00		8/3/94	1022000.00	0.00
IAL-SB12(SSC)	Dibenzofuran	60.00	J	8/3/94	8200000.00	0.00
IAL-SB12(SSC)	Dieldrin	150.00		8/3/94	102000.00	0.00
IAL-SB12(SSC)	Endosulfan II	20.00		8/3/94	12000000.00	0.00
IAL-SB12(SSC)	Fluoranthene	1800.00		8/3/94	82000000.00	0.00
IAL-SB12(SSC)	Fluorene	150.00	J	8/3/94	82000000.00	0.00
IAL-SB11(SSC)	Iron	20000.00		8/3/94	610000.00	0.03
IAL-SB11(0.5-2.5)	Manganese	611.00		8/3/94	10000.00	0.06
IAL-SB11(SSC)	Mercury	0.10		8/3/94	610.00	0.00
IAL-SB11(SSC)	Naphthalene	73.00	J	8/3/94	82000000.00	0.00
IAL-SB11(SSC)	Nickel	18.70		8/3/94	41000.00	0.00
IAL-SB12(SSC)	Phenanthrene	1400.00		8/3/94	61000000.00	0.00

Table 3-3
ERM Data
Hazard Indices for Soil Samples
Noncarcinogenic Constituents
By Sample Area
Middletown Airfield NPL Site
Middletown, Pennsylvania

Sample Name	Parameter	Maximum	Qualifier	Collection Date	Screening Level	Hazard Quotient
IAL-SB12(SSC)	Pyrene	3700.00		8/3/94	61000000.00	0.00
IAL-SB11(SSC)	Selenium	0.53		8/3/94	10000.00	0.00
IAL-SB12(0.5-2.5)	Silver	0.59		8/3/94	10000.00	0.00
IAL-SB12(0.5-2.5)	Thallium	0.25		8/3/94	160.00	0.00
IAL-SB11(SSC)	Total Cyanide (solid)	0.10		8/3/94	41000.00	0.00
IAL-SB12(SSC)	Vanadium	24.00		8/3/94	14000.00	0.00
IAL-SB12(SSC)	Zinc	123.00		8/3/94	610000.00	0.00
					Hazard Index	0.2
IAP-SB2(SSC)	1,2-Dichlorobenzene	77.00	J	8/1/94	180000000.00	0.00
IAP-ERM2S(SSC)	2-Methylnaphthalene	95.00	J	8/8/94	82000000.00	0.00
IAP-SB2(SSC)	Acenaphthene	160.00	J	8/1/94	120000000.00	0.00
IAP-SB2(SSC)	Acenaphthylene	180.00	J	8/1/94	82000000.00	0.00
IAP-SB2(SSC)	Aluminum	8310.00		8/1/94	1000000.00	0.01
IAP-SB2(SSC)	Anthracene	340.00	J	8/1/94	610000000.00	0.00
IAP-SB2(SSC)	Arsenic	8.30	J	8/1/94	610.00	0.01
IAP-ERM2S(SSC)	Barium	80.20		8/8/94	140000.00	0.00
IAP-SB2(SSC)	Benzo(g,h,i)perylene	1100.00		8/1/94	61000000.00	0.00
IAP-ERM2S(SSC)	Beryllium	0.64		8/8/94	10220.00	0.00
IAP-ERM2S(SSC)	bis(2-Ethylhexyl)phthalate	320.00	J	8/8/94	40880000.00	0.00
IAP-SB2(SSC)	Cadmium	2.10		8/1/94	1000.00	0.00
IAP-SB2(SSC)	Chromium	16.80		8/1/94	10000.00	0.00
IAP-SB2(SSC)	Cobalt	7.70		8/1/94	120000.00	0.00
IAP-SB2(SSC)	Copper	27.70		8/1/94	82000.00	0.00

Table 3-3
ERM Data
Hazard Indices for Soil Samples
Noncarcinogenic Constituents
By Sample Area
Middletown Airfield NPL Site
Middletown, Pennsylvania

Sample Name	Parameter	Maximum	Qualifier	Collection Date	Screening Level	Hazard Quotient
IAP-ERM2S(SSC)	DDT	20.00		8/8/94	1022000.00	0.00
IAP-ERM2S(SSC)	Di-n-butylphthalate	45.00	J	8/8/94	200000000.00	0.00
IAP-ERM2S(SSC)	Dibenzofuran	88.00	J	8/8/94	8200000.00	0.00
IAP-SB2(SSC)	Dieldrin	50.00		8/1/94	102000.00	0.00
IAP-ERM2S(SSC)	Fluoranthene	2900.00		8/8/94	82000000.00	0.00
IAP-SB2(SSC)	Fluorene	170.00	J	8/1/94	82000000.00	0.00
IAP-SB10(SSC)	Iron	17300.00		8/2/94	610000.00	0.03
IAP-ERM2S(SSC)	Manganese	592.00		8/8/94	10000.00	0.06
IAP-SB2(SSC)	Mercury	0.41		8/1/94	610.00	0.00
IAP-ERM2S(SSC)	Naphthalene	84.00	J	8/8/94	82000000.00	0.00
IAP-SB2(SSC)	Nickel	20.80		8/1/94	41000.00	0.00
IAP-ERM2S(SSC)	Phenanthrene	1700.00		8/8/94	61000000.00	0.00
IAP-SB2(SSC)	Pyrene	3400.00		8/1/94	61000000.00	0.00
IAP-ERM2S(SSC)	Selenium	0.26	J	8/8/94	10000.00	0.00
IAP-SB2(SSC)	Silver	2.00		8/1/94	10000.00	0.00
IAP-SB2(SSC)	Total Cyanide (solid)	0.20		8/1/94	41000.00	0.00
IAP-SB2(SSC)	Vanadium	20.90		8/1/94	14000.00	0.00
IAP-SB2(SSC)	Zinc	177.00		8/1/94	610000.00	0.00
					Hazard Index	0.1
MH-GS4(0.0-2.0)	Acetone	26.00	J	7/17/95	200000000.00	0.00
MH-GS3(0.0-2.0)	Aluminum	11200.00		7/18/95	1000000.00	0.01
MH-GS2(0.0-2.0)	Arsenic	4.70		7/18/95	610.00	0.01
MH-GS2(0.0-2.0)	Barium	77.90		7/18/95	140000.00	0.00

Table 3-3
ERM Data
Hazard Indices for Soil Samples
Noncarcinogenic Constituents
By Sample Area
Middletown Airfield NPL Site
Middletown, Pennsylvania

Sample Name	Parameter	Maximum	Qualifier	Collection Date	Screening Level	Hazard Quotient
MH-GS2(0.0-2.0)	Beryllium	0.80	J	7/18/95	10220.00	0.00
MH-GS2A(0.0-2.0)	bis(2-Ethylhexyl)phthalate	480.00		7/18/95	40880000.00	0.00
MH-GS1(0.0-2.0)	Cadmium	2.40		7/18/95	1000.00	0.00
MH-GS1(0.0-2.0)	Chromium	14.40		7/18/95	10000.00	0.00
MH-GS3(0.0-2.0)	Cobalt	7.30		7/18/95	120000.00	0.00
MH-GS3(0.0-2.0)	Copper	15.30		7/18/95	82000.00	0.00
MH-GS13A(0.0-2.0)	Ethylbenzene	2.00	J	7/18/95	200000000.00	0.00
MH-GS6(0.0-2.0)	Fluoranthene	80.00	J	7/17/95	82000000.00	0.00
MH-GS1(0.0-2.0)	Iron	17300.00		7/18/95	610000.00	0.03
MH-GS2(0.0-2.0)	Manganese	469.00	J	7/18/95	10000.00	0.05
MH-GS1(0.0-2.0)	Mercury	0.04		7/18/95	610.00	0.00
MH-GS8(0.0-2.0)	Methylene Chloride	6.00	J	7/17/95	122640000.00	0.00
MH-GS3(0.0-2.0)	Nickel	11.50		7/18/95	41000.00	0.00
MH-GS1(0.0-2.0)	Selenium	0.34	J	7/18/95	10000.00	0.00
MH-GS1(0.0-2.0)	Vanadium	24.70		7/18/95	14000.00	0.00
MH-GS13A(0.0-2.0)	Xylene (total)	8.00	J	7/18/95	1000000000.00	0.00
MH-GS2A(0.0-2.0)	Zinc	50.50		7/18/95	610000.00	0.00
					Hazard Index	0.1
RA-SB53(0.0-2.0)	Aluminum	8490.00		8/17/94	1000000.00	0.01
RA-SB53(0.0-2.0)	Arsenic	4.10		8/17/94	610.00	0.01
RA-SB53(0.0-2.0)	Barium	93.00		8/17/94	140000.00	0.00
RA-SB53(0.0-2.0)	Beryllium	0.66		8/17/94	10220.00	0.00
RA-SB53(0.0-2.0)	Chromium	14.60		8/17/94	10000.00	0.00

Table 3-3
ERM Data
Hazard Indices for Soil Samples
Noncarcinogenic Constituents
By Sample Area
Middletown Airfield NPL Site
Middletown, Pennsylvania

Sample Name	Parameter	Maximum	Qualifier	Collection Date	Screening Level	Hazard Quotient
RA-SB53(0.0-2.0)	Cobalt	5.80		8/17/94	120000.00	0.00
RA-SB53(0.0-2.0)	Copper	13.20		8/17/94	82000.00	0.00
RA-SB53(0.0-2.0)	Dieldrin	4.00	J	8/17/94	102000.00	0.00
RA-SB53(0.0-2.0)	Iron	12900.00		8/17/94	610000.00	0.02
RA-SB53(0.0-2.0)	Manganese	199.00		8/17/94	10000.00	0.02
RA-SB53(0.0-2.0)	Nickel	11.90		8/17/94	41000.00	0.00
RA-SB53(0.0-2.0)	Vanadium	17.60		8/17/94	14000.00	0.00
RA-SB53(0.0-2.0)	Zinc	41.00		8/17/94	610000.00	0.00
					Hazard Index	0.1

Note:
All data and their respective screening levels are in the same units. Organics are in µg/kg and inorganics are in mg/kg.

Table 3-4
Smith Data
Hazard Indices for Soil Samples
Noncarcinogenic Constituents
By Sample Area
Middletown Airfield NPL Site
Middletown, Pennsylvania

Sample Name	Parameter	Maximum	Qualifier	Collection Date	Screening Level	Hazard Quotient
IA-011-B-E1'	1,2-Dichlorobenzene	170.00	Jj	1/12/95	180000000.00	0.00
IA-019-B-E1'	2,4-Dinitrotoluene	210.00	Jj	1/9/95	4100000.00	0.00
IA-027-B-E1'	2-Methylnaphthalene	670.00		1/12/95	82000000.00	0.00
IA-020-B-ED1'	Acenaphthylene	350.00	j	1/9/95	82000000.00	0.00
IA-023-B-E1'	Aldrin	1.50	Jj	1/12/95	61000.00	0.00
IA-018-B-E1'	Alpha Chlordane	7.30	j	1/9/95	123000.00	0.00
IA-001-B-I1.5-5'	Aluminum	17900.00	j	1/13/95	1000000.00	0.02
IA-020-B-ED1'	Anthracene	220.00	Jj	1/9/95	610000000.00	0.00
IA-023-B-I1-5'	Antimony	2.61	[]l	1/12/95	820.00	0.00
IA-026-B-I1-5'	Arsenic	14.80	j	1/9/95	610.00	0.02
IA-005-B-I1-5'	Barium	208.00	l	1/10/95	140000.00	0.00
IA-026-B-E1'	Benzo(g,h,i)perylene	810.00		1/9/95	61000000.00	0.00
IA-001-B-I1.5-5'	Beryllium	1.56		1/13/95	10220.00	0.00
IA-005-B-I1-5'	Cadmium	8.11		1/10/95	1000.00	0.01
IA-005-B-I1-5'	Chromium	639.00		1/10/95	10000.00	0.06
IA-005-B-I1-5'	Cobalt	11.60	k	1/10/95	120000.00	0.00
IA-023-B-I1-5'	Copper	50.40		1/12/95	82000.00	0.00
IA-026-B-E1'	DDT	220.00	j	1/9/95	1022000.00	0.00
IA-001-B-E1.5'	Di-n-butylphthalate	150.00	Jj	1/13/95	200000000.00	0.00
IA-027-B-E1'	Dibenzofuran	75.00	Jj	1/12/95	8200000.00	0.00
IA-026-B-E1'	Dieldrin	56.00	Jj	1/9/95	102000.00	0.00
IA-019-B-E1'	Diethylphthalate	210.00	Jj	1/9/95	1000000000.00	0.00
IA-029-B-E1'	Endosulfan II	3.20	Jj	1/12/95	12000000.00	0.00
IA-026-B-E1'	Endosulfan Sulfate	37.00	Jj	1/9/95	12000000.00	0.00
IA-027-B-E1'	Endrin	21.00		1/12/95	610000.00	0.00
IA-026-B-E1'	Endrin Aldehyde	180.00	j	1/9/95	610000.00	0.00
IA-020-B-ED1'	Endrin Ketone	12.00	j	1/9/95	610000.00	0.00
IA-026-B-E1'	Fluoranthene	2600.00		1/9/95	82000000.00	0.00
IA-026-B-E1'	Fluorene	51.00	Jj	1/9/95	82000000.00	0.00
IA-005-B-E1'	Gamma BHC - Lindane	0.54	Jj	1/10/95	613000.00	0.00
IA-018-B-E1'	Gamma Chlordane	5.00	j	1/9/95	123000.00	0.00
IA-023-B-E1'	Heptachlor	0.85	Jj	1/12/95	1022000.00	0.00
IA-018-B-E1'	Heptachlor Epoxide	3.70	j	1/9/95	27000.00	0.00
IA-005-B-I1-5'	Iron	37500.00	j	1/10/95	610000.00	0.06
IA-005-B-I1-5'	Manganese	9230.00	j	1/10/95	10000.00	0.92
IA-026-B-I1-5'	Mercury	0.29		1/9/95	610.00	0.00
IA-005-B-E1'	Methoxychlor	4.70	Jj	1/10/95	10000000.00	0.00
IA-027-B-E1'	Naphthalene	630.00		1/12/95	82000000.00	0.00
IA-005-B-I1-5'	Nickel	19.20		1/10/95	41000.00	0.00
IA-026-B-E1'	Phenanthrene	750.00		1/9/95	61000000.00	0.00
IA-026-B-E1'	Pyrene	2900.00	j	1/9/95	61000000.00	0.00
IA-005-B-I1-5'	Selenium	2.10	j	1/10/95	10000.00	0.00
IA-001-B-I1.5-5'	Thallium	0.16	[]	1/13/95	160.00	0.00
IA-026-B-E1'	Total PCB's	1500.00		1/9/95	41000.00	0.04
IA-005-B-I1-5'	Vanadium	138.00		1/10/95	14000.00	0.01
IA-005-B-I1-5'	Zinc	280.00	j	1/10/95	610000.00	0.00
					Hazard Index	1
LA-016-B-E1'	1,2-Dichlorobenzene	230.00	Jj	11/10/94	180000000.00	0.00
LA-006-B-E1'	2-Methylnaphthalene	640.00	Jj	11/10/94	82000000.00	0.00
LA-006-B-E1'	Acenaphthene	1500.00	Jj	11/10/94	120000000.00	0.00
LA-008-B-E1'	Acenaphthylene	1200.00	Jj	11/9/94	82000000.00	0.00
LA-001-B-E1'	Aldrin	13.00	Jj	11/9/94	61000.00	0.00
LA-013-B-E1'	Alpha Chlordane	16.00	Jj	11/11/94	123000.00	0.00
LA-007-B-I1-5'	Aluminum	11800.00		11/9/94	1000000.00	0.01
LA-006-B-E1'	Anthracene	4000.00		11/10/94	610000000.00	0.00

Table 3-4
Smith Data
Hazard Indices for Soil Samples
Noncarcinogenic Constituents
By Sample Area
Middletown Airfield NPL Site
Middletown, Pennsylvania

Sample Name	Parameter	Maximum	Qualifier	Collection Date	Screening Level	Hazard Quotient
LA-015-B-I1-4'	Arsenic	14.20		11/10/94	610.00	0.02
LA-008-B-I1-4'	Barium	90.30		11/9/94	140000.00	0.00
LA-008-B-E1'	Benzo(g,h,i)perylene	2200.00	Jj	11/9/94	61000000.00	0.00
LA-002-B-I1-5'	Beryllium	0.74	[]	11/9/94	10220.00	0.00
LA-015-B-I1-4'	Cadmium	17.30	l	11/10/94	1000.00	0.02
LA-015-B-I1-4'	Chromium	213.00		11/10/94	10000.00	0.02
LA-007-B-I1-5'	Cobalt	14.30	[]k	11/9/94	120000.00	0.00
LA-015-B-I1-4'	Copper	32.40		11/10/94	82000.00	0.00
LA-011-B-E1'	DDT	4200.00	j	11/10/94	1022000.00	0.00
LA-016-B-E1'	Di-n-butylphthalate	190.00	Jj	11/10/94	200000000.00	0.00
LA-006-B-E1'	Dibenzofuran	910.00	Jj	11/10/94	8200000.00	0.00
LA-014-B-E1'	Dieldrin	160.00	j	11/10/94	102000.00	0.00
LA-012-B-E1'	Diethylphthalate	80.00	Jj	11/11/94	1000000000.00	0.00
LA-007-B-E1'	Endosulfan I	8.90	Jj	11/9/94	12000000.00	0.00
LA-007-B-E1'	Endosulfan II	37.00	Jj	11/9/94	12000000.00	0.00
LA-014-B-E1'	Endosulfan Sulfate	34.00	Jj	11/10/94	12000000.00	0.00
LA-007-B-E1'	Endrin	130.00	j	11/9/94	610000.00	0.00
LA-016-B-E1'	Endrin Aldehyde	24.00	Jl	11/10/94	610000.00	0.00
LA-013-B-E1'	Endrin Ketone	76.00	Jj	11/11/94	610000.00	0.00
LA-006-B-E1'	Fluoranthene	11000.00		11/10/94	82000000.00	0.00
LA-006-B-E1'	Fluorene	2600.00	Jj	11/10/94	82000000.00	0.00
LA-016-B-E1'	Gamma Chlordane	28.00	Jl	11/10/94	123000.00	0.00
LA-013-B-E1'	Heptachlor Epoxide	23.00	Jj	11/11/94	27000.00	0.00
LA-016-B-I1-5'	Iron	26800.00	j	11/10/94	610000.00	0.04
LA-013-B-ED1'	Isophorone	49.00	Jj	11/11/94	408800000.00	0.00
LA-009-B-I1-4'	Manganese	934.00		11/10/94	10000.00	0.09
LA-014-B-I1-4'	Mercury	0.27		11/10/94	610.00	0.00
LA-006-B-E1'	Methoxychlor	8.20	Jj	11/10/94	10000000.00	0.00
LA-017-B-E1'	Naphthalene	250.00	Jj	11/10/94	82000000.00	0.00
LA-007-B-I1-5'	Nickel	21.30	k	11/9/94	41000.00	0.00
LA-006-B-E1'	Phenanthrene	14000.00		11/10/94	61000000.00	0.00
LA-013-B-ED1'	Phenol	49.00	Jj	11/11/94	1000000000.00	0.00
LA-006-B-E1'	Pyrene	13000.00		11/10/94	61000000.00	0.00
LA-015-B-I1-4'	Selenium	0.84	[]l	11/10/94	10000.00	0.00
LA-015-B-I1-4'	Silver	3.05	k	11/10/94	10000.00	0.00
LA-016-B-E1'	Total PCB's	1100.00		11/10/94	41000.00	0.03
LA-016-B-I1-5'	Vanadium	21.30		11/10/94	14000.00	0.00
LA-018-B-I1-5'	Zinc	87.50	j	11/10/94	610000.00	0.00
LA-016-B-E1'	bis(2-Ethylhexyl)phthalate	970.00	j	11/10/94	40880000.00	0.00
					Hazard Index	0.3
PS-014-B-E1'	2-Methylnaphthalene	200.00	Jj	1/12/95	82000000.00	0.00
PS-014-B-E1'	Acenaphthylene	330.00	Jj	1/12/95	82000000.00	0.00
PS-014-B-E1'	Aldrin	1.00	Jj	1/12/95	61000.00	0.00
PS-016-B-E1'	Alpha Chlordane	5.50		1/12/95	123000.00	0.00
PS-015-B-I1-5'	Aluminum	12200.00	j	1/12/95	1000000.00	0.01
PS-016-B-E1'	Anthracene	350.00	Jj	1/12/95	610000000.00	0.00
PS-007-B-I1-5'	Arsenic	7.56	l	1/11/95	610.00	0.01
PS-015-B-I1-5'	Barium	116.00	j	1/12/95	140000.00	0.00
PS-014-B-E1'	Benzo(g,h,i)perylene	1300.00	Jj	1/12/95	61000000.00	0.00
PS-015-B-I1-5'	Beryllium	0.68	[]	1/12/95	10220.00	0.00
PS-007-B-I1-5'	Cadmium	6.32		1/11/95	1000.00	0.01
PS-015-B-I1-5'	Chromium	17.50		1/12/95	10000.00	0.00
PS-011-B-I1-5'	Cobalt	15.10	k	1/11/95	120000.00	0.00
PS-014-B-I1-4'	Copper	19.10		1/12/95	82000.00	0.00
PS-015-B-E1'	DDT	19.00	j	1/12/95	1022000.00	0.00

Table 3-4
Smith Data
Hazard Indices for Soil Samples
Noncarcinogenic Constituents
By Sample Area
Middletown Airfield NPL Site
Middletown, Pennsylvania

Sample Name	Parameter	Maximum	Qualifier	Collection Date	Screening Level	Hazard Quotient
PS-006-B-E1'	Di-n-butylphthalate	98.00	Jj	1/11/95	200000000.00	0.00
PS-002-B-E1'	Dieldrin	87.00	Dj	1/11/95	102000.00	0.00
PS-014-B-E1'	Endosulfan II	15.00	j	1/12/95	12000000.00	0.00
PS-014-B-E1'	Endosulfan Sulfate	2.50	Jj	1/12/95	12000000.00	0.00
PS-014-B-E1'	Endrin	13.00	j	1/12/95	610000.00	0.00
PS-014-B-E1'	Endrin Aldehyde	35.00	j	1/12/95	610000.00	0.00
PS-015-B-E1'	Endrin Ketone	4.10	j	1/12/95	610000.00	0.00
PS-016-B-E1'	Fluoranthene	2600.00		1/12/95	82000000.00	0.00
PS-012-B-E1'	Gamma BHC - Lindane	0.72	Jj	1/11/95	613000.00	0.00
PS-016-B-E1'	Gamma Chlordane	6.60		1/12/95	123000.00	0.00
PS-014-B-E1'	Heptachlor	0.87	Jj	1/12/95	1022000.00	0.00
PS-016-B-E1'	Heptachlor Epoxide	2.80		1/12/95	27000.00	0.00
PS-007-B-I1-5'	Iron	34400.00		1/11/95	610000.00	0.06
PS-004-B-I1-5'	Manganese	533.00		1/11/95	10000.00	0.05
PS-007-B-I1-5'	Mercury	0.19		1/11/95	610.00	0.00
PS-010-B-E1'	Methoxychlor	0.90	Jj	1/11/95	10000000.00	0.00
PS-014-B-E1'	Naphthalene	210.00	Jj	1/12/95	82000000.00	0.00
PS-015-B-I1-5'	Nickel	16.50		1/12/95	41000.00	0.00
PS-016-B-E1'	Phenanthrene	1300.00	Jj	1/12/95	61000000.00	0.00
PS-014-B-E1'	Pyrene	4800.00	j	1/12/95	61000000.00	0.00
PS-017-B-I1-5'	Selenium	0.58	[]I	1/11/95	10000.00	0.00
PS-012-B-I1-5'	Vanadium	38.10		1/11/95	14000.00	0.00
PS-016-B-I1-5'	Zinc	147.00	j	1/12/95	610000.00	0.00
					Hazard Index	0.1
RW-071-B-E1'	2-Methylnaphthalene	2000.00	Jj	11/16/94	82000000.00	0.00
RW-071-B-E1'	Acenaphthene	9100.00	Jj	11/16/94	120000000.00	0.00
RW-071-B-E1'	Acenaphthylene	2800.00	Jj	11/16/94	82000000.00	0.00
RW-013-B-E1'	Aldrin	35.00	Jj	12/2/94	61000.00	0.00
RW-093-B-E1'	Alpha Chlordane	2.10	Jj	11/16/94	123000.00	0.00
RW-132-B-I1-5'	Aluminum	40000.00		11/15/94	1000000.00	0.04
RW-071-B-E1'	Anthracene	36000.00		11/16/94	610000000.00	0.00
RW-052-B-I1-5'	Arsenic	18.30	l	11/30/94	610.00	0.03
RW-002-B-I1-5'	Barium	542.00	l	11/29/94	140000.00	0.00
RW-071-B-E1'	Benzo(g,h,i)perylene	11000.00	Jj	11/16/94	61000000.00	0.00
RW-132-B-I1-5'	Beryllium	5.16		11/15/94	10220.00	0.00
RW-001-B-E1'	Butylbenzylphthalate	120.00	Jj	11/29/94	410000000.00	0.00
RW-036-R-I(1-5')	Cadmium	8.38	l	12/6/94	1000.00	0.01
RW-029-R-I(1-5')	Chromium	198.00	l	12/6/94	10000.00	0.02
RW-101-B-I1-5'	Cobalt	14.30	k	11/15/94	120000.00	0.00
RW-064-B-I1-4'	Copper	37.50	j	11/16/94	82000.00	0.00
RW-043-B-I1-5'	Cyanide	7.52	l	12/19/94	41000.00	0.00
RW-035-B-ED1'	DDT	13.00	k	12/20/94	1022000.00	0.00
RW-106-B-E1'	Di-n-butylphthalate	290.00	Jj	11/17/94	200000000.00	0.00
RW-071-B-E1'	Dibenzofuran	9100.00	Jj	11/16/94	8200000.00	0.00
RW-095-B-E1'	Dieldrin	430.00		12/6/94	102000.00	0.00
RW-108-B-E1'	Diethylphthalate	150.00	Jj	11/16/94	1000000000.00	0.00
RW-093-B-E1'	Endosulfan I	1.70	Jj	11/16/94	12000000.00	0.00
RW-097-B-E1'	Endosulfan II	15.00	Jj	11/15/94	12000000.00	0.00
RW-071-B-E1'	Endosulfan Sulfate	37.00	Jj	11/16/94	12000000.00	0.00
RW-071-B-E1'	Endrin	60.00	Jj	11/16/94	610000.00	0.00
RW-071-B-E1'	Endrin Aldehyde	120.00	Jj	11/16/94	610000.00	0.00
RW-071-B-E1'	Endrin Ketone	52.00	Jj	11/16/94	610000.00	0.00
RW-071-B-E1'	Fluoranthene	130000.00		11/16/94	82000000.00	0.00
RW-071-B-E1'	Fluorene	21000.00		11/16/94	82000000.00	0.00
RW-003-B-E1'	Gamma BHC - Lindane	1.10	Jj	12/6/94	613000.00	0.00

Table 3-4
Smith Data
Hazard Indices for Soil Samples
Noncarcinogenic Constituents
By Sample Area
Middletown Airfield NPL Site
Middletown, Pennsylvania

Sample Name	Parameter	Maximum	Qualifier	Collection Date	Screening Level	Hazard Quotient
RW-085-B-E1'	Gamma Chlordane	1.60	Jj	11/16/94	123000.00	0.00
RW-093-B-E1'	Heptachlor	3.80	Jj	11/16/94	1022000.00	0.00
RW-005-B-E1'	Heptachlor Epoxide	8.20	Jj	12/6/94	27000.00	0.00
RW-026-B-I1-5'	Iron	41900.00	j	12/19/94	610000.00	0.07
RW-029-R-I(1-5')	Manganese	5320.00	j	12/6/94	10000.00	0.53
RW-026-B-I1-5'	Mercury	0.91		12/19/94	610.00	0.00
RW-074-B-E1'	Methoxychlor	35.00	Jk	11/30/94	10000000.00	0.00
RW-074-B-E1'	Naphthalene	1100.00	Jj	11/30/94	82000000.00	0.00
RW-053-B-I1-5'	Nickel	21.20		12/7/94	41000.00	0.00
RW-071-B-E1'	Phenanthrene	150000.00		11/16/94	61000000.00	0.00
RW-071-B-E1'	Pyrene	93000.00		11/16/94	61000000.00	0.00
RW-113-B-I1-5'	Selenium	7.32	l	11/15/94	10000.00	0.00
RW-133-B-I1-5'	Silver	2.66	k	12/1/94	10000.00	0.00
RW-093-B-I1-5'	Thallium	0.34	[]l	11/16/94	160.00	0.00
RW-013-B-E1'	Total PCB's	520.00		12/2/94	41000.00	0.01
RW-084-B-I1-5'	Vanadium	39.00	l	11/16/94	14000.00	0.00
RW-065-B-I1-5'	Zinc	88.40		11/16/94	610000.00	0.00
RW-092-B-E1'	bis(2-Ethylhexyl)phthalate	210.00	Jj	11/16/94	40880000.00	0.00
					Hazard Index	0.7
TA-015-B-E1'	2-Methylnaphthalene	550.00	Jj	1/19/95	82000000.00	0.00
TA-034-B-E1'	4-Methylphenol	110.00	Jj	1/24/95	10000000.00	0.00
TA-006-B-E1'	Acenaphthene	270.00	Jj	1/23/95	120000000.00	0.00
TA-015-B-E1'	Acenaphthylene	6500.00		1/19/95	82000000.00	0.00
TA-034-B-E1'	Aldrin	34.00	j	1/24/95	61000.00	0.00
TA-049-B-E1'	Alpha Chlordane	95.00	Dj	1/19/95	123000.00	0.00
TA-002-B-I1-5'	Aluminum	19500.00	j	1/25/95	1000000.00	0.02
TA-015-B-E1'	Anthracene	3000.00		1/19/95	610000000.00	0.00
TA-053-B-S-I1-5'	Arsenic	15.00		1/23/95	610.00	0.02
TA-042-B-I1-5'	Barium	334.00	j	1/19/95	140000.00	0.00
TA-036-B-E1'	Benzo(g,h,i)perylene	3500.00	Jj	1/24/95	61000000.00	0.00
TA-002-B-I1-5'	Beryllium	1.85		1/25/95	10220.00	0.00
TA-023-B-I1-5'	Cadmium	11.60	l	1/19/95	1000.00	0.01
TA-042-B-I1-5'	Chromium	640.00	l	1/19/95	10000.00	0.06
TA-010-B-I1-4.5'	Cobalt	13.30		1/17/95	120000.00	0.00
TA-042-B-I1-5'	Copper	84.20	l	1/19/95	82000.00	0.00
TA-031-B-E1'	DDT	140.00		1/24/95	1022000.00	0.00
TA-006-B-E1'	Di-n-butylphthalate	110.00	Jj	1/23/95	2000000000.00	0.00
TA-006-B-E1'	Dibenzofuran	120.00	Jj	1/23/95	8200000.00	0.00
TA-031-B-E1'	Dieldrin	440.00	j	1/24/95	102000.00	0.00
TA-036-B-E1'	Endosulfan I	2.60	Jj	1/24/95	12000000.00	0.00
TA-031-B-E1'	Endosulfan II	4.30	j	1/24/95	12000000.00	0.00
TA-015-B-E1'	Endosulfan Sulfate	28.00	j	1/19/95	12000000.00	0.00
TA-036-B-E1'	Endrin	40.00		1/24/95	610000.00	0.00
TA-047-B-E1'	Endrin Aldehyde	100.00	j	1/24/95	610000.00	0.00
TA-036-B-E1'	Endrin Ketone	64.00	j	1/24/95	610000.00	0.00
TA-015-B-E1'	Fluoranthene	9600.00		1/19/95	82000000.00	0.00
TA-006-B-E1'	Fluorene	380.00		1/23/95	82000000.00	0.00
TA-002-B-E1'	Gamma BHC - Lindane	1.10	Jj	1/25/95	613000.00	0.00
TA-049-B-E1'	Gamma Chlordane	85.00	D	1/19/95	123000.00	0.00
TA-013-B-E1'	Heptachlor	0.35	Jj	1/17/95	1022000.00	0.00
TA-015-B-E1'	Heptachlor Epoxide	12.00	j	1/19/95	27000.00	0.00
TA-051-B-I.5-2'	Iron	46900.00	j	1/18/95	610000.00	0.08
TA-042-B-I1-5'	Manganese	13700.00	j	1/19/95	10000.00	1.37
TA-053-B-S-I1-5'	Mercury	0.42		1/23/95	610.00	0.00
TA-046-B-ED1'	Methoxychlor	20.00		1/23/95	10000000.00	0.00

Table 3-4
Smith Data
Hazard Indices for Soil Samples
Noncarcinogenic Constituents
By Sample Area
Middletown Airfield NPL Site
Middletown, Pennsylvania

Sample Name	Parameter	Maximum	Qualifier	Collection Date	Screening Level	Hazard Quotient
TA-015-B-E1'	Naphthalene	740.00	Jj	1/19/95	82000000.00	0.00
TA-042-B-I1-5'	Nickel	23.70		1/19/95	41000.00	0.00
TA-015-B-E1'	Phenanthrene	4000.00		1/19/95	61000000.00	0.00
TA-015-B-E1'	Pyrene	17000.00	D	1/19/95	61000000.00	0.00
TA-002-B-I1-5'	Selenium	6.80	j	1/25/95	10000.00	0.00
TA-036-B-I1-5'	Thallium	0.77	[]j	1/24/95	160.00	0.00
TA-006-B-E1'	Total PCB's	1200.00		1/23/95	41000.00	0.03
TA-042-B-I1-5'	Vanadium	167.00	l	1/19/95	14000.00	0.01
TA-042-B-I1-5'	Zinc	746.00	j	1/19/95	610000.00	0.00
TA-053-B-E1'	bis(2-Ethylhexyl)phthalate	510.00		1/23/95	40880000.00	0.00
					Hazard Index	2
WA-012-B-E(1')	2-Methylnaphthalene	2800.00		7/7/94	82000000.00	0.00
WA-012-B-E(1')	4-Methylphenol	280.00	Jj	7/7/94	10000000.00	0.00
WA-012-B-E(1')	Acenaphthene	5600.00	J	7/7/94	120000000.00	0.00
WA-021-B-E(1')	Acenaphthylene	280.00	Jj	7/7/94	82000000.00	0.00
WA-013-B-E(1')	Aldrin	31.00	i	7/6/94	61000.00	0.00
WA-012-B-E(1')	Alpha Chlordane	17.00	Jj	7/7/94	123000.00	0.00
WA-020-B-I(1-5')	Aluminum	15700.00	j	7/7/94	1000000.00	0.02
WA-012-B-E(1')	Anthracene	9900.00		7/7/94	610000000.00	0.00
WA-012-B-I(1-4')	Antimony	19.40	l	7/7/94	820.00	0.02
WA-023-B-I(1-4')	Arsenic	73.00	j	7/7/94	610.00	0.12
WA-012-B-I(1-4')	Barium	277.00	j	7/7/94	140000.00	0.00
WA-012-B-E(1')	Benzo(g,h,i)perylene	6300.00		7/7/94	61000000.00	0.00
WA-007-B-I(1-5')	Beryllium	1.03	[]	7/6/94	10220.00	0.00
WA-029-B-E(1')	Butylbenzylphthalate	770.00	j	7/8/94	410000000.00	0.00
WA-035-B-I(1-5')	Cadmium	20.20	k	7/8/94	1000.00	0.02
WA-012-B-I(1-4')	Chromium	405.00	j	7/7/94	10000.00	0.04
WA-012-B-I(1-4')	Cobalt	32.20		7/7/94	120000.00	0.00
WA-012-B-I(1-4')	Copper	103.00	j	7/7/94	82000.00	0.00
WA-037-B-E(1')	DDT	140.00	D	7/8/94	1022000.00	0.00
WA-012-B-E(1')	Dibenzofuran	4200.00		7/7/94	8200000.00	0.00
WA-023-B-E(1')	Dieldrin	3.30	Jj	7/7/94	102000.00	0.00
WA-012-B-E(1')	Diethylphthalate	260.00	Jj	7/7/94	1000000000.00	0.00
WA-013-B-E(1')	Endosulfan I	9.60	Jj	7/6/94	12000000.00	0.00
WA-036-B-E(1')	Endosulfan II	11.00	j	7/8/94	12000000.00	0.00
WA-012-B-E(1')	Endrin	140.00	j	7/7/94	610000.00	0.00
WA-018-B-E(1')	Endrin Aldehyde	31.00		7/7/94	610000.00	0.00
WA-012-B-E(1')	Endrin Ketone	77.00	Jj	7/7/94	610000.00	0.00
WA-012-B-E(1')	Fluoranthene	40000.00	y	7/7/94	82000000.00	0.00
WA-012-B-E(1')	Fluorene	5900.00		7/7/94	82000000.00	0.00
WA-013-B-E(1')	Gamma Chlordane	11.00	Jj	7/6/94	123000.00	0.00
WA-023-B-E(1')	Heptachlor	0.92	Jj	7/7/94	1022000.00	0.00
WA-013-B-E(1')	Heptachlor Epoxide	21.00	j	7/6/94	27000.00	0.00
WA-011-B-I(1-3')	Iron	82500.00		7/7/94	610000.00	0.14
WA-011-B-I(1-3')	Manganese	9770.00	j	7/7/94	10000.00	0.98
WA-012-B-I(1-4')	Mercury	2.03	k	7/7/94	610.00	0.00
WA-012-B-E(1')	Naphthalene	9000.00		7/7/94	82000000.00	0.00
WA-012-B-I(1-4')	Nickel	174.00	j	7/7/94	41000.00	0.00
WA-012-B-E(1')	Phenanthrene	40000.00	y	7/7/94	61000000.00	0.00
WA-012-B-E(1')	Phenol	240.00	Jj	7/7/94	1000000000.00	0.00
WA-012-B-E(1')	Pyrene	29000.00	yj	7/7/94	61000000.00	0.00
WA-012-B-I(1-4')	Selenium	3.02		7/7/94	10000.00	0.00
WA-011-B-I(1-3')	Silver	3.25		7/7/94	10000.00	0.00
WA-023-B-I(1-4')	Thallium	0.43	[]k	7/7/94	160.00	0.00
WA-015-B-E(1')	Total PCB's	69.00		7/6/94	41000.00	0.00

Table 3-4
Smith Data
Hazard Indices for Soil Samples
Noncarcinogenic Constituents
By Sample Area
Middletown Airfield NPL Site
Middletown, Pennsylvania

Sample Name	Parameter	Maximum	Qualifier	Collection Date	Screening Level	Hazard Quotient
WA-011-B-I(1-3')	Vanadium	156.00 j		7/7/94	14000.00	0.01
WA-012-B-I(1-4')	Zinc	301.00 j		7/7/94	610000.00	0.00
WA-028-B-E(1')	bis(2-Ethylhexyl)phthalate	1700.00 Jj		7/8/94	40880000.00	0.00
					Hazard Index	1

Note:
All data and their respective screening levels are in the same units. Organics are in µg/kg and inorganics are in mg/kg.

manganese. Manganese is a naturally occurring constituent in soils, and its presence is not considered to be a site-related.

It should also be noted that the RBC for manganese is based on a reference dose of 0.005 mg/kg/day. The current reference dose for nondietary oral exposures to manganese (i.e., ingestion of soil or drinking water) is 0.047 mg/kg/day. Thus, the hazard quotients shown on Tables 3-3 and 3-4 are too high by approximately an order of magnitude. Using the recalculated reference dose, it may be seen that all of the estimated hazard indices are less than one.

In reviewing the results of this analysis, the following points should be noted.

- No constituents were excluded from this screening; that is, all positively reported constituents were carried through the screening, regardless of their detection frequency, their association with background conditions, or other factors.
- The maximum detected concentration of each constituent in each area was used in the calculation of potential risk, regardless of other constituents were found in similar locations. This approach results in very conservative estimates of potential risk, since it assumes that a worker is routinely and frequently exposed to the maximum concentrations.
- Industrial RBCs utilize standard, default exposure assumptions to characterize worker exposure (i.e., exposure occurs 250 days per year over a 25 year period). Worker exposures to soils at this Site are likely to be much less than this, since workers would not be expected to have routine contact with soils as a result of their normal activities.
- RBCs do not address dermal contact. The significance of this exposure route varies for different chemicals. However, it is worth noting that, for the primary constituents detected at this site (i.e., PAHs and inorganics), exposure via dermal contact is limited by the fact that they are poorly absorbed across the skin. In light of the conservative assumptions used to estimate cumulative risks, it is not expected that the exclusion of this exposure route from the risk calculations resulted in an underestimation of potential risk.
- Screening levels were available for all constituents with the exception of calcium, lead, magnesium, potassium, sodium. Of these, four constituents are essential nutrients (i.e., calcium, magnesium, potassium, and sodium), and their evaluation is not typically required

in a risk assessment (USEPA, 1989). They are also naturally occurring constituents, frequently found at percent levels in undisturbed soils (Dragun, 1988).

- In the absence of an RBC for lead, the reported concentrations were compared to an interim guideline level of 1,000 mg/kg (OSWER Directive 9355.4-12; USEPA, 1994) for industrial soils. All reported concentrations in the ERM data were below this level. Only a single exceedence of this level was reported in the Smith Data (i.e., 2,250 mg/kg, in sample IA-018), out of a total of 280 samples. In light of the very low frequency of exceedence of the screening level, lead is not considered to be a constituent of concern.

Soil data collected from the Meade Heights Area were evaluated against both industrial and residential RBCs. Although these soil samples were not collected from residential areas, it was recognized that there may be a potential for occasional exposure to these soils by nearby residents, and thus a comparison to residential RBCs has been included to provide additional perspective. Comparison to industrial RBCs is presented on Table 3-1 and Table 3-3. Comparison to residential RBCs is presented below for organic and inorganic constituents.

Organic Constituent	Concentration (µg/kg)	RBC (µg/kg)
Acetone	26	7,800,000
DEHP	480	46,000
Ethylbenzene	2	7,800,000
Fluoranthene	80	3,100,000
Methylene Chloride	6	85,000
Xylene	8	160,000,000

Inorganic Constituent	Concentration (mg/kg)	RBC (mg/kg)
Aluminum	1,200	78,000
Arsenic	4.7	0.43
Barium	77.9	5,500
Beryllium	0.8	0.15
Cadmium	2.4	39
Chromium	14.4	390
Cobalt	7.3	4,700
Copper	15.3	3,100
Iron	17,300	23,000
Manganese	469	390
Mercury	0.04	23
Nickel	11.5	1,600
Selenium	0.34	390
Vanadium	24.7	550
Zinc	50.5	23,000

As shown, all constituents were well below residential RBCs, with the exception of arsenic, beryllium, and manganese. However, the maximum reported concentrations of these constituents were well within the range of levels detected in background soil samples collected during the SSI, as shown below:

Constituent	Concentration (mg/kg)	Range (mg/kg)
Arsenic	4.7	0.11 - 18.7
Manganese	469	216 - 2330
Beryllium	0.8	0.41 - 2.5

Also, as noted above, the RBC for manganese is based on a reference dose of 0.005 mg/kg/day. The current reference dose is approximately an order of magnitude higher (0.047 mg/kg/day; Integrated Risk Information System, USEPA, 1996), which would result in an RBC approximately an order of magnitude higher than the 390 mg/kg value shown above. Using the current reference dose, the manganese RBC becomes 3,700 mg/kg, well above the maximum reported concentration.

Thus, based on the data collected in the SSI, no unacceptable levels of risk to human receptors appear to be associated with soils in the Meade Heights area.

3.2.1.2 *Leaching*

Reported soil concentrations in the Industrial Areas were also evaluated in order to assess the potential for soil constituents to leach to ground water. This analysis involved comparing all data (i.e., data from all depths) to a set of conservative, default leaching screening levels proposed by USEPA (USEPA, 1995a). As described below, reported concentrations of VOCs, PAHs, and inorganics exceeded the default leaching screening levels (a complete list of exceedences is included in Appendix F); however, the random distribution and low frequency of many specific exceedences did not suggest that the soils represent a discrete source of ground water contamination. The following specific points were also noted.

- The primary constituent of concern in ground water is TCE. However, TCE was only detected at concentrations above the leaching screening level (0.20 µg/kg) in 13 of 200 soil samples collected in the Industrial Areas. In locations where TCE was detected, it was generally found only at a single depth interval, suggesting that it is not migrating downward from a detectable source.

- Reported concentrations of TCE were all less than the TCE Act 2 screening level for the ground water protection pathway (2,000 µg/kg) developed by PADEP. Although the PADEP Act 2 levels are not promulgated criteria, they provide additional information to suggest that reported TCE concentrations in soil do not represent a source of the TCE found in ground water.

- Other chlorinated solvents were also detected (e.g., 1,2-DCE, vinyl chloride); however, like TCE, their occurrence was very limited, and did not suggest the presence of ~~a significant~~ source. 1,2-DCE was detected in 7 of 200 samples collected by ERM; similarly, vinyl chloride was only positively detected in 2 of 200 samples collected by ERM (i.e., sample IAP-SB-3 and duplicate sample SB-3A at a depth of 3 - 5 feet). Similar detection frequencies were reported for the Smith data (see Appendix F). In addition, with regard to vinyl chloride, it should be noted that review by data validation chemists of these laboratory samples indicated that the vinyl chloride results were suspect, since field duplicate precision criteria were not meant.

- A number of PAH compounds were also found in excess of USEPA's default leaching screening levels. However, as with TCE and the other volatile compounds, the occurrence of these constituents does not suggest that industrial soils are serving as a source of these constituents. In addition, extensive ground water monitoring data from the Site has not demonstrated these constituents to be present in ground water at levels above MCLs or USEPA Region III tap water RBCs. It is also worth noting that PAHs are characterized by low water solubilities and high organic carbon partitioning coefficients; thus, they tend to sorb to organic carbon in soil, rather than to dissolve in precipitation percolating through the vadose zone or in ground water. This tendency serves to significantly reduce the mobility of PAHs in the subsurface environment (ATSDR, 1993d).
- Dieldrin was also reported above the leaching screening level in random locations across the Site. Previous studies have not identified dieldrin as site-related, although it has been found in both soil and ground water; this conclusion was reiterated in the 1990 ROD. Furthermore, there is no known source that used dieldrin. In the absence of a source, it is most likely that dieldrin (a persistent pesticide now banned by USEPA; USEPA, 1993a) is likely to be present as a result of regional conditions
- A number of inorganic constituents exceeded leaching screening levels, as well. Barium, chromium, and nickel were among the inorganics most frequently found above their respective screening levels. However, review of the ground water data for filtered samples indicated that the only heavy metal to exceed its screening criterion was nickel. Dissolved concentrations of nickel exceeded the MCL in two monitoring wells, RFW-04 and ERM-23D, both located on the south side of Building 142. (Note that dissolved phase concentrations of iron and manganese in ground water also exceeded their screening levels; however, these constituents have not been shown to be site-related, and their presence in ground water is expected to reflect regional or background conditions).

- The leaching screening levels for inorganics are very low, and in many cases (including barium, chromium, and nickel), the screening levels are less than the reported background levels.

3.2.2 *Ground Water*

Potable water is supplied to the majority of the Site as well as to areas surrounding the Site by the Harrisburg International Airport (HIA) Water Department. Thus, for the majority of the Site, there is no direct use of untreated ground water. There is a small area north of the active Industrial Area (where residential wells RES-07 and RES-08 are located) and south of the North Base Landfill (where residential well RES-02 is located) where ground water is used for residential supply. Ground water underlying the Site discharges to the Susquehanna River.

The following sections describe the evaluation of ground water for the Industrial Areas, the North Base Landfill Area sentinel wells, and the residential wells. In addition, the ground water discharge pathway is briefly discussed.

3.2.2.1 *Industrial Areas*

The HIA Water Department operates multiple production wells in the Industrial Areas; water from these wells is treated prior to its introduction into HIA's water distribution system. Furthermore, existing institutional controls require that any new wells in the Industrial Areas be incorporated into the existing water treatment/distribution system. Thus, there are no current or potential exposures to untreated ground water from the Industrial Areas; note that this includes wells in the active Industrial Area, as well as the Lagoon Area, the Runway Area, and the North Base Landfill (with the exception of the sentinel wells, which are discussed separately, below). These areas were considered together because ground water use is restricted throughout this portion of the Site.

Data from wells in the Industrial Areas were screened against MCLs. The primary constituent of concern in ground water within these areas is TCE. Out of 110 samples collected, TCE was detected above the MCL (5 μg/l) in 70 samples. Concentrations in these wells ranged from 6 μg/l (in wells GF-218, GF-309A, and HIA-1) to 1,000 μg/l (well RFW-03, adjacent to well HIA-13).

Other chlorinated volatile constituents were also detected above MCLs (1,2-dichlorobenzene, 1,2-DCE, 1,4-dichlorobenzene, carbon tetrachloride, chlorobenzene, methylene chloride, PCE, and vinyl chloride) in wells in the Industrial Areas; however, they were typically detected at concentrations above the MCL in fewer than 5 percent of the samples.

Other organic constituents detected included DEHP (detected above the MCL in only 4 locations), DDT (detected in only 1 well), and dieldrin (detected in 10 locations). Inorganic constituents were also detected; however, as noted previously, the only dissolved phase constituent to exceed its MCL was nickel (which exceeded its MCL in 2 locations).

3.2.2.2 *North Base Landfill/Sentinel Wells*

Data collected during the SSI from new and existing wells in the vicinity of the North Base Landfill, including quarterly data from the sentinel wells, were compared to MCLs; Region III RBCs for tap water were used for constituents without MCLs. The results of this comparison are presented in Appendix F.

Review of the data from the sentinel wells indicated that the only organic constituent detected above its MCL was DEHP; it was reported in 7 of the 9 wells at concentrations from 2 µg/l to 54 µg/l (the MCL for DEHP is 6 µg/l). Dissolved concentrations of iron and manganese were above their secondary MCLs in sentinel well nests ERM-7(SENT) and ERM-8(SENT). Dissolved concentrations of manganese above its secondary MCL were also found in sentinel well nest ERM-9(SENT).

3.2.2.3 *Residential Wells*

Data collected during the SSI from the residential wells (including the Oddfellows Home well, RES-06) were compared to Region III RBCs for tap water, and cumulative risks were calculated following the procedures used above for evaluation of soils. As shown on Tables 3-5, potential carcinogenic risks were within the range of acceptable risks defined previously. Hazard indices (Table 3-6) were also less than one for all of the wells with the exception of RES-06. In this well, the estimated hazard index was equal to 7; iron and manganese were the dominant contributors to the hazard index. Neither of these constituents has been identified as being a site-related constituent of concern, and both of these constituents occur naturally in soil and ground water. Also, as noted previously, the RBC for manganese is based on a reference dose of 0.005 mg/kg/day. If the hazard quotient (i.e., the ratio of the concentration to the RBC) for manganese is recalculated using the current reference dose (0.047 mg/kg/day; IRIS, 1996), then the hazard quotient for manganese is well

Table 3-5
ERM Data
Cumulative Risks for
Carcinogenic Constituents in
Residential Wells
Middletown Airfield NPL Site
Middletown, Pennsylvania

Sample Name	Parameter	Maximum	Qualifier	Collection Date	Screening Level	Risk Level
RES-01	bis(2-Ethylhexyl)phthalate	1.000	J	6/5/95	4.800	2E-07
RES-02	Dieldrin	0.008	J	6/5/95	0.004	2E-06
RES-05	Alpha Chlordane	0.008	J	6/5/95	0.052	1.54E-07
RES-05	Gamma Chlordane	0.007	J	6/5/95	0.052	1.35E-07
				Cumulative Sum:		3E-07
RES-06	Trichloroethene	2.000	J	5/22/95	1.600	1E-06
RES-08	Arsenic	4.500	J	6/5/95	0.045	1E-04

Note:
All data and their respective screening levels are in the same units. All data are in µg/l.

Table 3-6
ERM Data
Hazard Indices for
Noncarcinogenic Constituents in
Residential Wells
Middletown Airfield NPL Site
Middletown, Pennsylvania

Sample Name	Parameter	Maximum	Qualifier	Collection Date	Screening Level	Hazard Quotient
RES-01	Acetone	8.000	J	6/21/94	3700.000	0.00
RES-01	Barium	412.000		6/5/95	2600.000	0.16
RES-01	Copper	141.000		6/21/94	1500.000	0.09
RES-01	Selenium	3.000		6/5/95	180.000	0.02
RES-01	bis(2-Ethylhexyl)phthalate	1.000	J	6/5/95	730.000	0.00
					Hazard Index	0.3
RES-02	Barium	344.000		6/5/95	2600.000	0.13
RES-02	Copper	21.600		6/5/95	1500.000	0.01
RES-02	Dieldrin	0.008	J	6/5/95	1.800	0.00
RES-02	Selenium	2.800		6/5/95	180.000	0.02
RES-02	Zinc	136.000		6/5/95	11000.000	0.01
					Hazard Index	0.2
RES-03	Aluminum	209.000		5/23/95	37000.000	0.01
RES-03	Barium	266.000		5/23/95	2600.000	0.10
RES-03	Copper	59.300		5/23/95	1500.000	0.04
RES-03	Iron	11000.000		5/23/95	11000.000	1.00
RES-03	Manganese	41.600		5/23/95	180.000	0.23
RES-03	Zinc	384.000		5/23/95	11000.000	0.03
					Hazard Index	1
RES-04	Barium	817.000		6/5/95	2600.000	0.31
RES-04	Copper	9.900		6/5/95	1500.000	0.01
					Hazard Index	0.3
RES-05	Alpha Chlordane	0.008	J	6/5/95	2.200	0.00
RES-05	Barium	311.000		6/5/95	2600.000	0.12
RES-05	Copper	73.000		6/5/95	1500.000	0.05
RES-05	Gamma Chlordane	0.007	J	6/5/95	2.200	0.00
RES-05	Selenium	3.400		6/5/95	180.000	0.02
RES-05	Zinc	111.000		6/5/95	11000.000	0.01
					Hazard Index	0.2
RES-06	Aluminum	562.000		5/22/95	37000.000	0.02
RES-06	Barium	355.000		5/22/95	2600.000	0.14
RES-06	Copper	59.300	J	5/22/95	1500.000	0.04
RES-06	Iron	35000.000	J	5/22/95	11000.000	3.18
RES-06	Manganese	635.000		5/22/95	180.000	3.53
RES-06	Trichloroethene	2.000	J	5/22/95	37.000	0.05
RES-06	Vanadium	13.600		5/22/95	260.000	0.05
RES-06	Zinc	26.800		5/22/95	11000.000	0.00
					Hazard Index	7
RES-07	Barium	169.000		6/5/95	2600.000	0.07
RES-07	Copper	23.200		6/5/95	1500.000	0.02
RES-07	Selenium	2.200		6/5/95	180.000	0.01
RES-07	Zinc	6.700		6/5/95	11000.000	0.00
					Hazard Index	0.1

Table 3-6
ERM Data
Hazard Indices for
Noncarcinogenic Constituents in
Residential Wells
Middletown Airfield NPL Site
Middletown, Pennsylvania

Sample Name	Parameter	Maximum	Qualifier	Collection Date	Screening Level	Hazard Quotient
RES-08	Arsenic	4.500	J	6/5/95	11.000	0.41
RES-08	Barium	390.000		6/5/95	2600.000	0.15
RES-08	Copper	163.000		6/5/95	1500.000	0.11
					Hazard Index	0.7

below one. Finally, it should also be noted that this location is served by public water, and that this well has not been used since 1981 (Personal Communication with Joel Frank, May 1996).

The significance of these results in relation to risk management criteria is discussed further in Section 4.

3.2.2.4 *Ground Water Discharge*

Ground water at the Site discharges to the Susquehanna River. The significance of this exposure pathway was evaluated using actual monitoring data, as discussed in Section 3.2.3.

3.2.3 *Surface Water/Sediment (Susquehanna River)*

Human exposure to surface water and sediment in the vicinity of the Site is limited by restricted access to the shore line in the area surrounding the HIA Airport. Furthermore, the water is very shallow in the portion of the River immediately offshore from the Site. Thus, (because of limited access and because of the shallow water), wading, swimming, water-skiing and other recreational activities are not expected to occur routinely in this area; if any such activities do occur, they are likely to be infrequent.

Thus, the primary potential route of exposure would be through ingestion of fish caught in the portion of the Susquehanna River adjacent to the Site. This exposure pathway is applicable only for bioaccumulative constituents (e.g., pesticides, PCBs, mercury); these constitutes are discussed below.

- Both pesticides and PCBs were occasionally detected in both surface water and sediment, in both upstream (or background; i.e., SR-SED-8) and downstream samples (Table 3-7). However, because of the limited and sporadic detections of these compounds in both surface water and sediment, this exposure pathway does not appear to be significant. In addition, there is no known site source for these constituents, and previous investigations have not identified them as constituents of concern.
- Mercury was only sporadically detected in surface water samples from both upstream and downstream locations, indicating that bioaccumulation of mercury from surface water is not likely to represent a significant exposure pathway; however, mercury was more frequently detected in sediment samples from both upstream and downstream locations (in 27 of 35 samples). As described below, a simple partitioning approach was used to determine if the reported

Table 3-7
Summary of Location and Frequency
of Detection of Select Constituents
Middletown Airfield NPL Site
Middletown, Pennsylvania

Constituent	Sampling Event	1	2	3	4	5	6	7
Sample Name	Sampling Quarter	May-94	Aug-94	Nov-94	Mar-95	Jun-95	Sep-95	Nov-95
SED-5								
DDD	µg/kg					5		
DDE	µg/kg					2	2	
DDT	µg/kg					4	3	
Gamma chlordane	µg/kg							
PCB-1254	µg/kg				300			
PCB-1260	µg/kg							
Mercury	mg/kg	0.097	0.33	0.33	0.064 B	0.035	0.024	0.032
SED-6								
DDD	µg/kg					8		
DDE	µg/kg					4		5
DDT	µg/kg					4		
Gamma chlordane	µg/kg						2	
PCB-1254	µg/kg					130		
PCB-1260	µg/kg							70
Mercury	mg/kg	0.096	0.13		0.070 B	0.097	0.05	0.19
SED-7								
DDD	µg/kg					5.5		
DDE	µg/kg					4.5		6.5
DDT	µg/kg					4		9*
Gamma chlordane	µg/kg					3		
PCB-1254	µg/kg					75		
PCB-1260	µg/kg							
Mercury	mg/kg	0.078		0.28*	0.12	0.125	0.043	0.16
SED-8								
DDD	µg/kg					5		
DDE	µg/kg					3	16	5
DDT	µg/kg				40	4	4	3
Gamma chlordane	µg/kg							
PCB-1254	µg/kg					60		
PCB-1260	µg/kg							
Mercury	mg/kg	0.1		0.16	0.069 B	0.055	0.067	0.11

Notes:
Blanks denote no positive detection of the constituent in a given quarter.
B- Qualitatively invalid result due to laboratory contaminants.
* denotes that the value is an average of one positive detection and one-half the detection limit from the duplicate. The average may be higher than the positive detection.

levels could pose a potentially unacceptable risk through the ingestion of bottom dwelling fish (e.g., catfish) who may be exposed to sediment in this area.

- Using a distribution coefficient (Kd) of 10 l/kg (Baes, 1984), and the maximum sediment concentration detected in a downstream sample (Csed = 0.5 mg/kg, SR-SED-7[1]),an interstitial pore water concentration (Cpw) of 0.05 mg/l was calculated (i.e., Csed/Kd = Cpw).

- A fish tissue concentration was then estimated as the product of the interstitial pore water concentration (Cpw = 0.05 mg/l) and the bioconcentration factor (BCF, equal to 5,500 l/kg; USEPA, 1986). Thus, the concentration of mercury in fish tissue was estimated to be 280 mg/kg; this exceeds the USEPA Region III mercury RBC for fish tissue (0.41 mg/kg).

- A similar calculation was done to evaluate the maximum mercury concentration detected in an upstream sample (Csed = 0.16 mg/kg; SR-SED-8, 16 November 1994). Using this concentration, the estimated mercury concentration in fish tissue was 90 mg/kg, also well in excess of the RBC.

These calculations are very simplistic and very conservative, but may be used to provide some preliminary perspective regarding the fish ingestion pathway. It should be noted that the RBC is based on frequent and routine consumption of fish from the same source, rather than for occasional recreational fishing, as would be expected to occur in the vicinity of the Site.

It should be noted that exposure to mercury via the fish ingestion pathway is also likely to be very limited, since most fishing for bottom-dwelling fish (who may be routinely exposed to sediment and to the interstitial pore water associated with the sediment) typically occurs from shore (rather than from a boat), and, as noted, access to the shore in the vicinity of the Airport is restricted. Also, mercury has not been found to be a site-related constituent of concern, based on the results of previous studies and the SSI.

1 Note that mercury was not reported in the duplicate sample collected from location SED-7 (i.e., SR-SED-7A, 11/94).

3.2.4 *Surface Water/Sediment (Meade Heights)*

The only positively detected constituents in surface water samples were inorganics. Review of these data suggested that upstream and downstream concentrations were generally consistent for most constituents and these concentrations were likely to reflect natural variability. Potential human exposure to these constituents is expected to be limited to children who may occasionally play or wade in the stream. Since inorganics are poorly absorbed across the skin (USEPA, 1992), no unacceptable levels of risk are expected to be associated with these constituents.

Several VOCs and PAHs, as well as inorganic constituents were reported in both upstream and downstream sediment samples from Meade Heights. Concentrations were generally similar, although in some cases, downstream concentrations did exceed upstream concentrations. Potential human exposure to these sediments is expected to be limited to occasional dermal contact during wading or playing in the stream. The low levels of constituents reported in the stream, and the limited potential for these constituents to be absorbed through the skin (USEPA, 1992) indicates that these exposures do not represent a significant risk.

3.3 *ECOLOGICAL SCREENING EVALUATION*

The Ecological Screening Evaluation for the Middletown Airfield Site consisted of a comparison of reported constituent concentrations in soil, surface water and sediment to USEPA Region III BTAG screening levels. Screening levels used in this evaluation were obtained from the USEPA Region III list of BTAG screening levels dated 9 August 1995 (USEPA, 1995b). These screening levels represent the lowest values from a combination of sources considered to be protective of the most sensitive organism in a medium.

The purpose of this evaluation was to identify areas and constituents of potential concern from an ecological perspective which require further consideration. The significance of constituents exceeding BTAG screening levels are further addressed in Section 4 to determine whether remediation of the identified areas and constituents is warranted. It should be emphasized that BTAG screening levels are very conservative, and exceedences of these levels do not necessarily indicate a potential threat to ecological receptors. The methods and results of the Ecological Screening Evaluation are discussed below by medium.

3.3.1 *Soil*

As described in Section 2.0, the Middletown Airfield NPL Site is almost entirely developed for industrial and urban uses, and there is very little undisturbed natural habitat. In addition, there are no federal or state threatened or endangered species and no critical environments in the vicinity of the Site. Therefore, because of the very conservative nature of the BTAG screening levels, the lack of natural habitat on-site and the absence of sensitive receptors, soil data collected from the Industrial Areas were initially compared to USEPA industrial RBCs to focus the evaluation on areas that, based on potential risk, required comparison with BTAG screening levels. The RBCs were reduced by an order of magnitude prior to use in the Ecological Screening Evaluation. Using this approach, the areas and constituents potentially posing the greatest risk to the environment were identified.

Soil data collected from the Penn State and Meade Heights areas were compared solely with BTAG screening levels. Although these areas are also largely developed for urban uses, the areas where the samples were collected likely provide habitat for some ecological receptors. Therefore, RBCs were not used to focus the screening evaluation.

The results of the data comparisons are discussed below by area. Following the discussion of the screening results, constituents for which BTAG screening levels were not available are considered.

3.3.1.1 *Industrial Areas*

The results of the data comparisons to industrial RBCs and BTAG screening levels are summarized in Appendix F. Several constituents were detected at levels which exceeded screening levels, as discussed below.

- Beryllium, lead and manganese were the only inorganic constituents to exceed RBCs and BTAG screening levels. It is worth noting that all reported beryllium concentrations were within the range of background (Table 3-8), with the exception of data collected from the Runway Area. The elevated beryllium in the Runway Area is likely associated with airport operations since the major emission source of beryllium to the environment is the combustion of coal and fuel oil (ATSDR, 1993b).
- Several PAHs exceeded screening levels in the Industrial Areas including benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene,

Table 3-8
Background Soils Constituent Concentration Ranges
Middletown Airfield NPL Site
Middletown, Pennsylvania

Parameter	Minimum	Qualifier	Units	Location of Minimum	Maximum	Qualifier	Units	Location of Maximum
1,1,1-Trichloroethane	15.000	UJ	µg/kg	BK-SB43(4.0-4.5)	22.000	U	µg/kg	BK-SB43(13.5-14.0)
1,1,2,2-Tetrachloroethane	15.000	UJ	µg/kg	BK-SB43(4.0-4.5)	22.000	U	µg/kg	BK-SB43(13.5-14.0)
1,1,2-Trichloroethane	15.000	UJ	µg/kg	BK-SB43(4.0-4.5)	22.000	U	µg/kg	BK-SB43(13.5-14.0)
1,1-Dichloroethane	15.000	UJ	µg/kg	BK-SB43(4.0-4.5)	22.000	U	µg/kg	BK-SB43(13.5-14.0)
1,1-Dichloroethene	15.000	UJ	µg/kg	BK-SB43(4.0-4.5)	22.000	U	µg/kg	BK-SB43(13.5-14.0)
1,2,4-Trichlorobenzene	360.000	U	µg/kg	BK-SB49A(5.0-8.5)	470.000	U	µg/kg	BK-SB43(SSC)
1,2-Dichlorobenzene	15.000	UJ	µg/kg	BK-SB43(4.0-4.5)	470.000	U	µg/kg	BK-SB43(SSC)
1,2-Dichloroethane	15.000	UJ	µg/kg	BK-SB43(4.0-4.5)	22.000	U	µg/kg	BK-SB43(13.5-14.0)
1,2-Dichloroethene,cis	15.000	UJ	µg/kg	BK-SB43(4.0-4.5)	22.000	U	µg/kg	BK-SB43(13.5-14.0)
1,2-Dichloroethene,trans	15.000	UJ	µg/kg	BK-SB43(4.0-4.5)	22.000	U	µg/kg	BK-SB43(13.5-14.0)
1,2-Dichloropropane	15.000	UJ	µg/kg	BK-SB43(4.0-4.5)	22.000	U	µg/kg	BK-SB43(13.5-14.0)
1,3-Dichlorobenzene	15.000	UJ	µg/kg	BK-SB43(4.0-4.5)	470.000	U	µg/kg	BK-SB43(SSC)
1,4-Dichlorobenzene	15.000	UJ	µg/kg	BK-SB43(4.0-4.5)	470.000	U	µg/kg	BK-SB43(SSC)
2,4,5-Trichlorophenol	360.000	U	µg/kg	BK-SB49A(5.0-8.5)	470.000	U	µg/kg	BK-SB43(SSC)
2,4,6-Trichlorophenol	360.000	U	µg/kg	BK-SB49A(5.0-8.5)	470.000	U	µg/kg	BK-SB43(SSC)
2,4-Dichlorophenol	360.000	U	µg/kg	BK-SB49A(5.0-8.5)	470.000	U	µg/kg	BK-SB43(SSC)
2,4-Dimethylphenol	360.000	U	µg/kg	BK-SB49A(5.0-8.5)	470.000	U	µg/kg	BK-SB43(SSC)
2,4-Dinitrophenol	900.000	U	µg/kg	BK-SB49(5.0-8.5)	1200.000	U	µg/kg	BK-SB45(5.0-10.0)
2,4-Dinitrotoluene	360.000	U	µg/kg	BK-SB49A(5.0-8.5)	470.000	U	µg/kg	BK-SB43(SSC)
2,6-Dinitrotoluene	360.000	U	µg/kg	BK-SB49A(5.0-8.5)	470.000	U	µg/kg	BK-SB43(SSC)
2-Butanone	15.000	UJ	µg/kg	BK-SB43(4.0-4.5)	22.000	U	µg/kg	BK-SB43(13.5-14.0)
2-Chloronaphthalene	360.000	U	µg/kg	BK-SB49A(5.0-8.5)	470.000	U	µg/kg	BK-SB43(SSC)
2-Chlorophenol	360.000	U	µg/kg	BK-SB49A(5.0-8.5)	470.000	U	µg/kg	BK-SB43(SSC)
2-Hexanone	15.000	UJ	µg/kg	BK-SB43(4.0-4.5)	22.000	U	µg/kg	BK-SB43(13.5-14.0)
2-Methylnaphthalene	44.000	J	µg/kg	BK-SB43(0.2-0.5)	620.000		µg/kg	BK-SB45(2.0-5.0)
2-Methylphenol	360.000	U	µg/kg	BK-SB49A(5.0-8.5)	470.000	U	µg/kg	BK-SB43(SSC)
2-Nitroaniline	360.000	U	µg/kg	BK-SB49A(5.0-8.5)	470.000	U	µg/kg	BK-SB43(SSC)
2-Nitrophenol	360.000	U	µg/kg	BK-SB49A(5.0-8.5)	470.000	U	µg/kg	BK-SB43(SSC)
3,3'-Dichlorobenzidine	730.000	U	µg/kg	BK-SB49(5.0-8.5)	960.000	U	µg/kg	BK-SB43(SSC)
3-Nitroaniline	360.000	U	µg/kg	BK-SB49A(5.0-8.5)	470.000	U	µg/kg	BK-SB43(SSC)
4,6-Dinitro-2-methylphenol	900.000	U	µg/kg	BK-SB49(5.0-8.5)	1200.000	U	µg/kg	BK-SB45(5.0-10.0)
4-Bromophenyl-phenylether	360.000	U	µg/kg	BK-SB49A(5.0-8.5)	470.000	U	µg/kg	BK-SB43(SSC)
4-Chloro-3-methylphenol	360.000	U	µg/kg	BK-SB49A(5.0-8.5)	470.000	U	µg/kg	BK-SB43(SSC)
4-Chloroaniline	360.000	U	µg/kg	BK-SB49A(5.0-8.5)	470.000	U	µg/kg	BK-SB43(SSC)
4-Chlorophenyl-phenylether	360.000	U	µg/kg	BK-SB49A(5.0-8.5)	470.000	U	µg/kg	BK-SB43(SSC)
4-Methyl-2-Pentanone	15.000	UJ	µg/kg	BK-SB43(4.0-4.5)	22.000	U	µg/kg	BK-SB43(13.5-14.0)
4-Methylphenol	360.000	U	µg/kg	BK-SB49A(5.0-8.5)	470.000	U	µg/kg	BK-SB43(SSC)
4-Nitroaniline	360.000	U	µg/kg	BK-SB49A(5.0-8.5)	470.000	U	µg/kg	BK-SB43(SSC)
4-Nitrophenol	900.000	U	µg/kg	BK-SB49(5.0-8.5)	1200.000	U	µg/kg	BK-SB45(5.0-10.0)
Acenaphthene	100.000	J	µg/kg	BK-SB44(SSC)	470.000	U	µg/kg	BK-SB43(SSC)
Acenaphthylene	54.000	J	µg/kg	BK-SB43(2.0-5.0)	440.000	U	µg/kg	BK-SB52(SSC)
Acetone	17.000		µg/kg	BK-SB51(9.5-10.0)	1300.000	J	µg/kg	BK-SB43(9.0-9.5)
Aldrin	10.000	U	µg/kg	BK-SB52(SSC)	10.000	U	µg/kg	BK-SB52(SSC)
Alpha BHC	10.000	U	µg/kg	BK-SB52(SSC)	10.000	U	µg/kg	BK-SB52(SSC)
Alpha Chlordane	50.000	U	µg/kg	BK-SB49A(5.0-8.5)	70.000	U	µg/kg	BK-SB52(SSC)
Aluminum	3300.000		µg/kg	BK-SB49(5.0-8.5)	21600.000		µg/kg	BK-SB46(SSC)
Amenable Cyanide (solid)	0.100	U	µg/kg	BK-SB52(SSC)	1.900		µg/kg	BK-SB46(SSC)
Anthracene	95.000	J	µg/kg	BK-SB44(0.2-0.5)	440.000	U	µg/kg	BK-SB52(SSC)
Antimony	7.600	U	mg/kg	BK-SB47(5.0-8.0)	13.800		mg/kg	BK-SB51(SSC)
Arsenic	0.110		mg/kg	BK-SB47(5.0-8.0)	18.700		mg/kg	BK-SB45(2.0-5.0)
Barium	33.000		mg/kg	BK-SB51(10.0-14.0)	228.000		mg/kg	BK-SB43A(10.0-14.0)
Benzene	15.000	UJ	µg/kg	BK-SB43(4.0-4.5)	22.000	U	µg/kg	BK-SB43(13.5-14.0)

Table 3-8
Background Soils Constituent Concentration Ranges
Middletown Airfield NPL Site
Middletown, Pennsylvania

Parameter	Minimum	Qualifier	Units	Location of Minimum	Maximum	Qualifier	Units	Location of Maximum
Benzo(a)anthracene	45.000	J	µg/kg	BK-SB50(0.2-0.5)	1000.000		µg/kg	BK-SB44(SSC)
Benzo(a)pyrene	46.000	J	µg/kg	BK-SB50(0.2-0.5)	1100.000		µg/kg	BK-SB44(SSC)
Benzo(b)fluoranthene	45.000	H	µg/kg	BK-SB47(SSC)	2300.000	H	µg/kg	BK-SB44(0.2-0.5)
Benzo(g,h,i)perylene	130.000	J	µg/kg	BK-SB46(0.2-0.5)	2100.000		µg/kg	BK-SB43(0.2-0.5)
Benzo(k)fluoranthene	360.000	U	µg/kg	BK-SB49A(5.0-8.5)	470.000	U	µg/kg	BK-SB43(SSC)
Beryllium	0.410		mg/kg	BK-SB51(5.0-10.0)	2.500		mg/kg	BK-SB45(2.0-5.0)
Beta BHC	10.000	U	µg/kg	BK-SB52(SSC)	10.000	U	µg/kg	BK-SB52(SSC)
Bromodichloromethane	15.000	UJ	µg/kg	BK-SB43(4.0-4.5)	22.000	U	µg/kg	BK-SB43(13.5-14.0)
Bromoform	15.000	UJ	µg/kg	BK-SB43(4.0-4.5)	22.000	U	µg/kg	BK-SB43(13.5-14.0)
Bromomethane	15.000	UJ	µg/kg	BK-SB43(4.0-4.5)	22.000	U	µg/kg	BK-SB43(13.5-14.0)
Butylbenzylphthalate	360.000	U	µg/kg	BK-SB49A(5.0-8.5)	470.000	U	µg/kg	BK-SB43(SSC)
Cadmium	0.540	U	mg/kg	BK-SB49(5.0-8.5)	1.800		mg/kg	BK-SB45(0.2-0.5)
Calcium	149.000		mg/kg	BK-SB51(2.0-5.0)	51800.000		mg/kg	BK-SB46(SSC)
Carbazole	360.000	U	µg/kg	BK-SB49A(5.0-8.5)	470.000	U	µg/kg	BK-SB43(SSC)
Carbon Disulfide	15.000	UJ	µg/kg	BK-SB43(4.0-4.5)	22.000	U	µg/kg	BK-SB43(13.5-14.0)
Carbon Tetrachloride	15.000	UJ	µg/kg	BK-SB43(4.0-4.5)	22.000	U	µg/kg	BK-SB43(13.5-14.0)
Chlorobenzene	15.000	UJ	µg/kg	BK-SB43(4.0-4.5)	22.000	U	µg/kg	BK-SB43(13.5-14.0)
Chloroethane	15.000	UJ	µg/kg	BK-SB43(4.0-4.5)	22.000	U	µg/kg	BK-SB43(13.5-14.0)
Chloroform	15.000	UJ	µg/kg	BK-SB43(4.0-4.5)	22.000	U	µg/kg	BK-SB43(13.5-14.0)
Chloromethane	15.000	UJ	µg/kg	BK-SB43(4.0-4.5)	22.000	U	µg/kg	BK-SB43(13.5-14.0)
Chromium	7.800		mg/kg	BK-SB51A(5.0-10.0)	53.600		mg/kg	BK-SB46(SSC)
Chrysene	42.000	J	µg/kg	BK-SB48(SSC)	1300.000		µg/kg	BK-SB44(SSC)
Cobalt	3.200		µg/kg	BK-SB49(2.0-5.0)	37.400		µg/kg	BK-SB46(0.2-0.5)
Copper	3.700		µg/kg	BK-SB49(5.0-8.5)	67.500		µg/kg	BK-SB45(5.0-10.0)
DDD	10.000	U	µg/kg	BK-SB52(SSC)	10.000	U	µg/kg	BK-SB52(SSC)
DDE	5.000	J	µg/kg	BK-SB46(0.2-0.5)	10.000	U	µg/kg	BK-SB52(SSC)
DDT	10.000	U	µg/kg	BK-SB52(SSC)	10.000	U	µg/kg	BK-SB52(SSC)
Delta BHC	10.000	U	µg/kg	BK-SB52(SSC)	10.000	U	µg/kg	BK-SB52(SSC)
Di-n-butylphthalate	360.000	U	µg/kg	BK-SB49A(5.0-8.5)	470.000	U	µg/kg	BK-SB43(SSC)
Di-n-octylphthalate	360.000	U	µg/kg	BK-SB49A(5.0-8.5)	470.000	U	µg/kg	BK-SB43(SSC)
Dibenz(a,h)anthracene	60.000	J	µg/kg	BK-SB45(5.0-10.0)	460.000	U	µg/kg	BK-SB45(2.0-5.0)
Dibenzofuran	78.000	J	µg/kg	BK-SB45(5.0-10.0)	470.000	U	µg/kg	BK-SB43(SSC)
Dibromochloromethane	15.000	UJ	µg/kg	BK-SB43(4.0-4.5)	22.000	U	µg/kg	BK-SB43(13.5-14.0)
Dieldrin	6.000	J	µg/kg	BK-SB51A(5.0-10.0)	239.000		µg/kg	BK-SB52(SSC)
Diethylphthalate	360.000	U	µg/kg	BK-SB49A(5.0-8.5)	470.000	U	µg/kg	BK-SB43(SSC)
Dimethylphthalate	360.000	U	µg/kg	BK-SB49A(5.0-8.5)	470.000	U	µg/kg	BK-SB43(SSC)
Endosulfan I	10.000	U	µg/kg	BK-SB52(SSC)	10.000	U	µg/kg	BK-SB52(SSC)
Endosulfan II	10.000	U	µg/kg	BK-SB52(SSC)	10.000	U	µg/kg	BK-SB52(SSC)
Endosulfan Sulfate	30.000	U	µg/kg	BK-SB51A(5.0-10.0)	40.000	U	µg/kg	BK-SB52(SSC)
Endrin	7.000	J	µg/kg	BK-SB44(SSC)	40.000	U	µg/kg	BK-SB45(2.0-5.0)
Endrin Aldehyde	100.000	U	µg/kg	BK-SB52(SSC)	100.000	U	µg/kg	BK-SB52(SSC)
Endrin Ketone	100.000	U	µg/kg	BK-SB52(SSC)	100.000	U	µg/kg	BK-SB52(SSC)
Ethylbenzene	15.000	UJ	µg/kg	BK-SB43(4.0-4.5)	22.000	U	µg/kg	BK-SB43(13.5-14.0)
Fluoranthene	43.000	J	µg/kg	BK-SB51(0.2-0.5)	2200.000		µg/kg	BK-SB44(SSC)
Fluorene	43.000	J	µg/kg	BK-SB43(0.2-0.5)	470.000	U	µg/kg	BK-SB43(SSC)
Gamma BHC - Lindane	10.000	U	µg/kg	BK-SB52(SSC)	10.000	U	µg/kg	BK-SB52(SSC)
Gamma Chlordane	50.000	U	µg/kg	BK-SB49A(5.0-8.5)	70.000	U	µg/kg	BK-SB52(SSC)
Heptachlor	10.000	U	µg/kg	BK-SB52(SSC)	10.000	U	µg/kg	BK-SB52(SSC)
Heptachlor Epoxide	10.000	U	µg/kg	BK-SB52(SSC)	10.000	U	µg/kg	BK-SB52(SSC)
Hexachlorobenzene	360.000	U	µg/kg	BK-SB49A(5.0-8.5)	470.000	U	µg/kg	BK-SB43(SSC)
Hexachlorobutadiene	360.000	U	µg/kg	BK-SB49A(5.0-8.5)	470.000	U	µg/kg	BK-SB43(SSC)
Hexachlorocyclopentadiene	360.000	U	µg/kg	BK-SB49A(5.0-8.5)	470.000	U	µg/kg	BK-SB43(SSC)

Table 3-8
Background Soils Constituent Concentration Ranges
Middletown Airfield NPL Site
Middletown, Pennsylvania

Parameter	Minimum	Qualifier	Units	Location of Minimum	Maximum	Qualifier	Units	Location of Maximum
Hexachloroethane	360.000	U	µg/kg	BK-SB49A(5.0-8.5)	470.000	U	µg/kg	BK-SB43(SSC)
Indeno(1,2,3-cd)pyrene	120.000	J	µg/kg	BK-SB46(0.2-0.5)	1600.000		µg/kg	BK-SB43(0.2-0.5)
Iron	8070.000		mg/kg	BK-SB49(5.0-8.5)	28900.000		mg/kg	BK-SB43A(10.0-14.0)
Isophorone	360.000	U	µg/kg	BK-SB49A(5.0-8.5)	470.000	U	µg/kg	BK-SB43(SSC)
Lead	3.400		mg/kg	BK-SB47(5.0-8.0)	82.300		mg/kg	BK-SB45(2.0-5.0)
Magnesium	302.000	J	mg/kg	BK-SB49(5.0-8.5)	15500.000		mg/kg	BK-SB46(SSC)
Manganese	216.000		mg/kg	BK-SB45(5.0-10.0)	2330.000		mg/kg	BK-SB45(SSC)
Mercury	0.050	U	mg/kg	BK-SB47(5.0-8.0)	0.700		mg/kg	BK-SB45(2.0-5.0)
Methoxychlor	50.000	U	µg/kg	BK-SB49A(5.0-8.5)	70.000	U	µg/kg	BK-SB52(SSC)
Methylene Chloride	16.000	U	µg/kg	BK-SB51(9.5-10.0)	3900.000	J	µg/kg	BK-SB43(9.0-9.5)
Moisture	8.300		µg/kg	BK-SB49(5.0-8.5)	30.500		µg/kg	BK-SB43(SSC)
N-Nitroso-di-n-propylamine	360.000	U	µg/kg	BK-SB49A(5.0-8.5)	470.000	U	µg/kg	BK-SB43(SSC)
N-Nitrosodiphenylamine	360.000	U	µg/kg	BK-SB49A(5.0-8.5)	470.000	U	µg/kg	BK-SB43(SSC)
Naphthalene	56.000	J	µg/kg	BK-SB43(SSC)	1200.000		µg/kg	BK-SB45(2.0-5.0)
Nickel	4.700		mg/kg	BK-SB49(2.0-5.0)	49.700		mg/kg	BK-SB46(SSC)
Nitrobenzene	360.000	U	µg/kg	BK-SB49A(5.0-8.5)	470.000	U	µg/kg	BK-SB43(SSC)
Pentachlorophenol	900.000	U	µg/kg	BK-SB49(5.0-8.5)	1200.000	U	µg/kg	BK-SB45(5.0-10.0)
Phenanthrene	40.000	J	µg/kg	BK-SB50(0.2-0.5)	1700.000		µg/kg	BK-SB44(SSC)
Phenol	360.000	U	µg/kg	BK-SB49A(5.0-8.5)	470.000	U	µg/kg	BK-SB43(SSC)
Potassium	253.000		µg/kg	BK-SB51(5.0-10.0)	2280.000		µg/kg	BK-SB45(2.0-5.0)
Pyrene	41.000	J	µg/kg	BK-SB51(0.2-0.5)	3600.000		µg/kg	BK-SB44(SSC)
Selenium	0.100	U	mg/kg	BK-SB51(10.0-14.0)	8.800		mg/kg	BK-SB45(2.0-5.0)
Silver	0.540	U	mg/kg	BK-SB49(5.0-8.5)	1.400		mg/kg	BK-SB46(0.2-0.5)
Sodium	216.000	U	mg/kg	BK-SB49(5.0-8.5)	544.000		mg/kg	BK-SB46(SSC)
Styrene	15.000	UJ	mg/kg	BK-SB43(4.0-4.5)	22.000	U	mg/kg	BK-SB43(13.5-14.0)
Tetrachloroethene	15.000	UJ	mg/kg	BK-SB43(4.0-4.5)	22.000	U	mg/kg	BK-SB43(13.5-14.0)
Thallium	0.130	J	mg/kg	BK-SB43(SSC)	0.280	UJ	mg/kg	BK-SB45(2.0-5.0)
Toluene	15.000	UJ	µg/kg	BK-SB43(4.0-4.5)	22.000	U	µg/kg	BK-SB43(13.5-14.0)
Total Cyanide (solid)	*0.100*	*J*	mg/kg	BK-SB52(SSC)	1.900		mg/kg	*BK-SB46(SSC)*
Toxaphene	2000.000	U	µg/kg	BK-SB52(0.2-0.5)	3000.000	U	µg/kg	BK-SB52(SSC)
Trichloroethene	15.000	UJ	µg/kg	BK-SB43(4.0-4.5)	22.000	U	µg/kg	BK-SB43(13.5-14.0)
Vanadium	6.200		µg/kg	BK-SB49(5.0-8.5)	23.600		µg/kg	BK-SB46(SSC)
Vinyl Acetate	15.000	UJ	µg/kg	BK-SB43(4.0-4.5)	22.000	U	µg/kg	BK-SB43(13.5-14.0)
Vinyl Chloride	15.000	UJ	µg/kg	BK-SB43(4.0-4.5)	22.000	U	µg/kg	BK-SB43(13.5-14.0)
Xylene (total)	15.000	UJ	µg/kg	BK-SB43(4.0-4.5)	22.000	U	µg/kg	BK-SB43(13.5-14.0)
Zinc	7.700	U	µg/kg	BK-SB49A(5.0-8.5)	212.000		µg/kg	BK-SB46(SSC)
bis(2-Chloroethoxy)methane	360.000	U	µg/kg	BK-SB49A(5.0-8.5)	470.000	U	µg/kg	BK-SB43(SSC)
bis(2-Chloroethyl)ether	360.000	U	µg/kg	BK-SB49A(5.0-8.5)	470.000	U	µg/kg	BK-SB43(SSC)
bis(2-Chloroisopropyl)ether	*360.000*	*U*	µg/kg	BK-SB49A(5.0-8.5)	*470.000*	*U*	µg/kg	*BK-SB43(SSC)*
bis(2-Ethylhexyl)phthalate	46.000	J	µg/kg	BK-SB52(0.2-0.5)	440.000	U	µg/kg	BK-SB52(SSC)
cis-1,3-Dichloropropene	15.000	UJ	µg/kg	BK-SB43(4.0-4.5)	22.000	U	µg/kg	BK-SB43(13.5-14.0)
trans-1,3-Dichloropropene	15.000	UJ	µg/kg	BK-SB43(4.0-4.5)	22.000	U	µg/kg	BK-SB43(13.5-14.0)

Note:
A qualifier containing a "U" denotes that the constituent was not positively detected.

benzo(k)fluoranthene, dibenz(a,h)anthracene and indeno(1,2,3-cd)pyrene. With respect to these results, it should be noted that the PAHs are believed to largely be associated with asphalt runoff and jet engine exhaust.

- Dieldrin, a common pesticide, frequently exceeded screening levels. Dieldrin has not been identified as a site-related constituent in previous investigations, and there are no known site-related sources or activities involving dieldrin. The 1990 ROD issued for the Site noted that the source of this constituent does not appear to be site-related (page 11).

- Other organic constituents which infrequently exceeded screening levels included DDT, PCB-1248 and PCB-1260. It should be noted that DDT exceeded screening levels in only one location. PCB-1248 and PCB-1260 exceeded screening levels in only one location and four locations, respectively. PCB-1248 exceeded screening levels in sample RW-013 which, based on the sampling log, was collected from an area of slag in the Runway Area. PCB-1260 exceeded the screening level at one location (IA-026; 32 samples were analyzed) in the Industrial Area (IA) samples. In addition, PCB-1260 exceeded the screening level at three locations (TA-006, TA-007, and TA-046; 57 samples were analyzed) in the Terminal Area (TA) samples. Two of the exceedence locations were adjacent to and beneath a parking area. The third exceedence was at a location approximately 1,300 feet west of the other two exceedences and adjacent to another parking area. Based on the infrequency of exceedences, the lack of an identifiable, concentrated source area and the lack of natural habitat in the areas of these exceedences, DDT, PCB-1248 and PCB-1260 are not expected to represent a potential threat to ecological receptors in the Industrial Areas.

3.3.1.2 *Penn State and Meade Heights Areas*

Soil samples collected by Smith Environmental from the Penn State campus and soil samples collected by ERM from the Meade Heights area were compared with BTAG screening levels. The results of the data comparisons are summarized in Appendix F and are discussed below.

- Various PAH constituents were reported above BTAG screening levels in samples collected from the walkway area connecting the Meade Heights housing area with the Penn State campus. These constituents included acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, chrysene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, pyrene and 2-methylnaphthalene. It should be noted that PAHs, with the exception of benzo(g,h,i)perylene at one location, were not reported above BTAG screening levels in samples collected from areas outside the walkway area. The reported concentrations of specific PAH compounds in the Penn State Area are generally similar to concentrations of PAHs in the Industrial Areas, although the maximum concentration of total PAHs in the Penn State area (maximum total PAHs = 13,950 µg/kg) is considerably less than the maximum concentration of total PAHs in the Industrial Areas (maximum total PAHs = 112,600 µg/kg).

- Several inorganic constituents were reported above screening levels in samples collected from the Penn State area, including aluminum, beryllium, cadmium, chromium, copper, lead, manganese, mercury, nickel, thallium, vanadium and zinc. It should be noted that, with the exception of cadmium and vanadium, all of the inorganic constituents were within the range of background. Reported concentrations of cadmium and vanadium were relatively consistent across the sampled area and only slightly greater than the background range. Thus, no single hot spot or source of these two inorganic constituents was identified, and reported concentrations are likely due to the heterogeneity of natural soils.
- The following inorganic constituents exceeded BTAG screening levels in samples collected from the Meade Heights Area: aluminum, beryllium, chromium, copper, lead, manganese, nickel, vanadium and zinc. However, reported concentrations of all these constituents were within the range of background.

3.3.1.3 *Constituents Without BTAG Screening Levels*

BTAG screening levels were not available for all positively detected constituents in soil. The following bullets summarize the constituents detected in soil for which no BTAG levels have been developed.

- N-Nitroso-di-n-propylamine was positively detected in only two locations in the Industrial Areas. One detection was in the Lagoon Area (LA-011) and the second detection was in the Runway Area (RW-080). Based on the isolated detections of this constituent and the lack of natural habitat in the Industrial Areas, it is not expected to pose a risk to ecological receptors.

- Semivolatile constituents and pesticides positively detected in samples collected from the Penn State campus included di-n-butylphthalate, endosulfan II, endosulfan sulfate, heptachlor, endrin aldehyde and endrin ketone. It should be noted that BTAG screening levels were available for heptachlor epoxide and endrin, and these screening levels were used as surrogates for the evaluation of heptachlor, endrin aldehyde and endrin ketone. The maximum reported concentration of heptachlor (0.87 μg/kg) was well below the screening level for heptachlor epoxide (100 μg/kg), and the maximum concentrations of endrin aldehyde (35 μg/kg) and endrin ketone (4.1 μg/kg) were well below the screening level for endrin (100 μg/kg). In addition, in order to evaluate the significance of reported concentrations of di-n-butylphthalate, endosulfan II and endosulfan sulfate, dietary benchmark values (i.e., concentrations of constituents in food) for wildlife were retrieved from the Data Base for Screening Benchmarks for Ecological Risk Assessment compiled by Oak Ridge National Laboratory (1996) for di-n-butylphthalate and endosulfan. The use of these numbers is considered conservative because wildlife receptors would be expected to ingest significantly less soil than food. The lowest available benchmark value for each constituent was selected for comparison with the Penn State soil data. The maximum concentrations of di-n-butylphthalate (98 μg/kg), endosulfan II (15 μg/kg) and endosulfan sulfate (2.5 μg/kg) were all less than the benchmark values for di-n-butylphthalate (115 μg/kg) and endosulfan (506 μg/kg). Thus, based on the above analysis, the presence of these constituents in soils does not represent a potential threat to ecological receptors.

- The only organic constituents lacking BTAG screening levels which were detected in soil samples collected from the Meade Heights area included acetone and DEHP. However, both acetone and DEHP are common laboratory contaminants (USEPA, 1989; ATSDR, 1993c), and were reported as quantitative estimates, with the exception of one DEHP detection. Thus, their presence in soils in the Meade Heights area is suspect.

3.3.2 *Surface Water/Sediment*

Quarterly surface water and sediment samples collected from the Susquehanna River and surface water and sediment samples collected from the Meade Heights tributary were compared with BTAG screening levels. Results of these data comparisons are discussed below by location.

3.3.2.1 *Susquehanna River*

Seven quarters of monitoring results were evaluated in this screening evaluation. The results of the comparison of quarterly surface water and sediment data with BTAG screening levels are summarized in Appendix F and are discussed below.

Surface Water

- The only organic constituents to exceed screening levels included alpha chlordane and gamma chlordane. It should be emphasized that these constituents were each detected at only one station during one quarterly sampling event out of seven (6 September 1995) and were not positively detected during the following sampling event (7 November 1995). Thus, these exceedences appear to be anomalous. The anomalous detection of these constituents does not represent a potential threat to ecological receptors.
- Aluminum and iron exceeded screening levels at all sampled locations (both upstream and downstream of the Site). However, it should be emphasized that downstream concentrations of both aluminum and iron were within the range of reported aluminum and iron concentrations at the upstream (i.e., background) station.
- Other inorganic constituents which exceeded screening levels included chromium, copper, cyanide, lead, mercury, silver and zinc. With respect to these results, several points should be made. All of these constituents, with the exception of zinc and cyanide, are within the range of reported constituent concentrations observed at the upstream (i.e., background) station. In addition, each of these constituents was infrequently detected and/or infrequently exceeded screening levels, as discussed below. Chromium and silver were each positively detected only at the upstream sampling location during one quarterly sampling event. In addition, silver was positively detected during the 16 November 1994 sampling event and has not been detected in subsequent sampling. Cyanide and mercury were each positively detected only twice. Cyanide only marginally exceeded the BTAG screening level in one location (6 μg/L versus the screening level of 5.2 μg/L), and one of the two mercury exceedences was from the upstream station. Copper and lead exceeded screening levels at only two locations, one of which was the upstream station. Downstream concentrations of copper (7.3 μg/L) and lead (9.6 μg/L) only marginally exceeded the BTAG screening levels of 6.5 μg/L and 3.2 μg/L, respectively. Finally, zinc exceeded screening levels at three

downstream stations and one upstream station. Zinc exceeded the BTAG screening level (30 µg/L) one time at location SW-5 (447 µg/L), two times at location SW-7 (36.5 µg/L and 34.8 µg/L) and one time at location SW-8 (336 µg/L). Reported concentrations of zinc vary widely from station to station and quarter to quarter. The downstream concentration of zinc at SW-5 is considered anomalous because, based on two subsequent rounds of sampling, this result has not been confirmed (i.e., one quarter zinc was not positively detected and the other quarter zinc was detected below the BTAG screening level). In addition, the other two downstream zinc concentrations discussed above only marginally exceed the BTAG screening level. These exceedences occurred at the same location but not during subsequent rounds of sampling.

Because several of these inorganic constituents were detected infrequently and/or exceeded screening levels infrequently and reported exceedences were often not confirmed in subsequent sampling events, these results suggest that impacts to the aquatic community would not be expected due to the presence of these inorganics in surface water.

Sediment

- Several PAHs exceeded screening levels in sediments, including acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, chrysene, dibenz(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, 2-methylnaphthalene, phenanthrene and pyrene. However, it should be emphasized that all reported downstream concentrations were within the range of the reported upstream concentrations (i.e., maximum PAH concentrations were observed at the background station). In addition, the only exceedence of screening levels by benzo(b)fluoranthene, benzo(g,h,i)perylene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene and 2-methylnaphthalene was at the upstream (i.e., background) location.
- Additional semivolatile constituents exceeding screening levels included butlybenzylphthalate and dibenzofuran. It should be noted that the only detection and exceedence of a screening level by dibenzofuran was at the upstream (i.e., background) location. In addition, reported downstream concentrations of butlybenzylphthalate were within the range of reported upstream concentrations.

- 4-Methylphenol and DEHP exceeded screening levels at both upstream and downstream stations. Reported concentrations of these constituents varied widely from quarter to quarter. For example, 4-methylphenol exceeded the screening level at location SW-5 in samples collected during the 7 March 1995 sampling event; however, both prior and subsequent sampling data for this location indicate that this constituent is either not positively detected or it is reported at concentrations less than the screening level. The same is true for the isolated exceedences reported at the remaining stations. The same variability is also observed with respect to the DEHP results. Finally, It should be emphasized that 4-methylphenol was positively detected in on Site soils at only three locations, and this constituent was not positively detected in ground water. Thus, there is no evidence of an on-site source for this constituent. DEHP was detected in both Site soils and ground water and is a ubiquitous laboratory contaminant (ATSDR, 1993c). However, concentrations in ground water in the wells nearest the river were less than both MCLs and AWQC, indicating that DEHP is not a constituent of concern in ground water discharging to the River.

- Pesticide compounds which exceeded screening levels in sediments included DDE and DDT. Reported downstream concentrations of DDE and DDT were within the range of reported upstream concentrations.

- PCB-1254 and PCB-1260 infrequently exceeded screening levels. It should be noted that PCB-1260 was positively detected at only one location during one quarterly sampling event (November 1995). In addition, PCB-1254 was positively detected once at each sampling location (most were during the June 1995 quarter), and these detections correspond to the reported exceedences. However, it is important to note that PCB-1254 was not positively detected at any of the sampling stations prior or subsequent to these isolated detections. It should be further emphasized that PCB-1254 was positively detected in on-site soils at only three locations, and this constituent was not positively detected in ground water. Thus, there is no evidence of an on-site source for this constituent. Because these constituents were infrequently detected and reported exceedences were often not confirmed in prior or subsequent sampling events, these results suggest that impacts to the aquatic community would not be expected due to the presence of these constituents in sediment.

- Several inorganic constituents exceeded screening levels, including arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc.

3.3.2.2 *Meade Heights*

Surface water and sediment samples were collected during the May 1994 stream survey of the Meade Heights tributary and were compared with BTAG screening levels. The results of the data comparisons are presented in Appendix F and are discussed below.

Surface Water

- The only exceedences of BTAG screening levels were by aluminum at the upstream (i.e., background) station and by iron at one downstream station. It should be noted that the reported concentration of iron was greater than the BTAG screening level protective of chronic exposures to invertebrates, but was lower than the BTAG screening level protective of chronic exposures to fish. Based on the limited distribution of these constituents at concentrations in excess of BTAG screening levels, reported concentrations of these constituents do not represent a potential threat to aquatic receptors.

Sediment

- The only exceedence of a BTAG screening level was by chromium at both downstream and upstream stations. Downstream concentrations of chromium were generally consistent with the upstream concentration. In addition, it should be noted that reported concentrations of chromium (4.4 mg/kg - 7.4 mg/kg) exceeded the screening level protective of flora (0.005 mg/kg), but were well below the screening level protective of fauna (260 mg/kg). Furthermore, the screening level for flora is based on impacts to tobacco, and potential impacts to this plant do not represent a concern in the Meade Heights tributary. Thus, the presence of this constituent in Meade Heights sediments does not represent a potential threat to aquatic receptors.

3.3.2.3 *Constituents Without BTAG Screening Levels*

BTAG screening levels were not available for all positively detected constituents in sediment. In order to evaluate the significance of reported concentrations of constituents lacking BTAG screening levels, sediment benchmark values were retrieved from the Data Base for Screening Benchmarks for Ecological Risk Assessment compiled by Oak Ridge National Laboratory. Sediment benchmarks were available for acetone, barium, carbon disulfide, chlordane, cyanide, 1,2-DCE, iron, manganese, methylene chloride, toluene and TCE. The results of data comparisons with these benchmark values is discussed in the following bullets.

- Reported concentrations of 1,2-DCE, methylene chloride, toluene and gamma chlordane in Susquehanna River sediment samples were less than available sediment benchmark values.

- Reported concentrations of acetone in Susquehanna River sediment samples exceeded the available sediment benchmark value. However, acetone is common laboratory contaminant, and acetone sediment results were frequently "B" qualified, indicating laboratory blank contamination. In addition, acetone has a very low organic-carbon partitioning coefficient (i.e., Koc) of 2.2 mg/L (USEPA, 1986) which indicates that acetone would not tend to sorb to sediments. Thus, the presence of acetone in Susquehanna River sediments is suspect.

- Sediment benchmark values were available for barium, iron, manganese and cyanide. Reported concentrations of each of these constituents in Susquehanna River sediment samples exceeded respective benchmark values. However, it is worth noting that reported downstream concentrations of cyanide were within the range of reported upstream concentrations.

- Reported concentrations of acetone, carbon disulfide, methylene chloride and TCE in Meade Heights sediment samples were less than their respective benchmark values. In addition, two of these constituents (i.e., acetone and methylene chloride) are common laboratory contaminants. Furthermore, carbon disulfide and TCE were each detected in only a single location. Thus, the presence of these constituents in sediments does not represent a potential threat to aquatic receptors.

- Reported concentrations of iron in Meade Heights sediment samples were less than the available benchmark value. In addition, manganese was reported at a concentration of 573 mg/kg at station MH-SED-3 and at a concentration of 417 mg/kg in the duplicate sample. These average of these two results is 495 mg/kg which only slightly exceeds the benchmark value for manganese of 460 mg/kg. All other reported concentrations of manganese in Meade Heights sediment samples were less than the benchmark value. Thus, the presence of these constituents in sediments does not represent a potential threat to aquatic receptors.

- Reported concentrations of barium in Meade Heights sediments exceeded the available benchmark value at both upstream and downstream stations.

Neither BTAG screening levels nor sediment benchmark values were available for the remaining constituents which are discussed in the following bullets.

- The following organic constituents lacking BTAG screening levels and benchmark values were positively detected in sediment samples from the Susquehanna River: 2-butanone, benzo(k)fluoranthene and carbazole. It should be noted that 2-butanone is a common laboratory contaminant and its presence in sediment is suspect. With respect to the remaining constituents, benzo(k)fluoranthene and carbazole, reported downstream concentrations were within the range of reported upstream concentrations.

- The following inorganic constituents lacking BTAG screening levels and benchmark values were positively detected in sediment samples from the Susquehanna River: aluminum, beryllium, cobalt, selenium, thallium, vanadium. Maximum concentrations of these constituents occurred at location SED-5 which is located near a discharge point for stormwater collected from the Site as well as from other industrial and commercial areas.

- Organic constituents lacking screening levels that were detected in Meade Heights sediment samples included 2-butanone. This constituent is a common laboratory contaminant, and it was detected in only a single location. Thus, its suspected presence in Meade Heights sediments does not represent a potential threat to aquatic receptors.

- Inorganic constituents lacking screening levels that were detected in Meade Heights sediment samples included aluminum, beryllium, cobalt and vanadium.

3.4 *SUMMARY*

The following sections summarize the results of the human health and the ecological screening evaluations.

3.4.1 *Human Health Evaluation*

The results of the human health screening evaluation are summarized below. This information was further assessed in the Risk Management Analysis (Section 4).

- Potential carcinogenic risks associated with exposure to soils under an industrial worker scenario were estimated to fall within the range of acceptable risk defined by USEPA (i.e., 1×10^{-6} to 1×10^{-4}).

- Evaluation of potential noncarcinogenic risks associated with exposure to soils (also under an industrial worker scenario) resulted in a hazard index equal to or less than one for all but one area. Only the soil samples collected by Smith in the Terminal Area had constituent concentrations which yielded a hazard index in excess of one. This exceedence was almost entirely due to manganese, which has not been identified as a site-related constituent. It should be noted that this evaluation was based on RBCs developed by USEPA Region III (USEPA, 1995a). Using the current reference dose for manganese (0.047 mg/kg/day; Integrated Risk Information System, 1996), the resulting hazard index estimated for the Terminal Area was also less than one (i.e., less than USEPA's guideline for evaluation of noncarcinogenic risk); a hazard index less than one indicates that no adverse health effects are anticipated to be associated with the defined conditions of exposure.

- Soil constituents did not appear to represent a source of ground water contamination, based on random exceedences of leaching screening levels for many constituents, and on the type of constituents detected in ground water.

- Potential exposures to ground water are limited by institutional controls in the Industrial Areas. Ground water samples collected from residential wells outside of the Industrial Areas yielded only a few exceedences of RBCs. The total estimated risks and hazard indices were within USEPA's range of acceptable risk, with one exception. The total hazard index calculated for residential well RES-06 exceeded one, primarily as a result of iron and manganese concentrations. These constituents are not known to be related to site activities.

- TCE was also detected in residential well RES-06 at a concentration slightly in excess of its RBC but less than its MCL. It should be noted that this well has not been used for water supply since 1981, when this location was added to the HIA potable water distribution system (Personal Communication, Joel Frank, May 1996)

- Surface water and sediment concentrations in both the Susquehanna River and in Meade Heights are generally not expected to pose an unacceptable risk to human receptors based on limited opportunity for exposure to these media, and on the type and frequency of constituents detected. Preliminary evaluation of the bioaccumulation of mercury in bottom-dwelling fish did suggest that this may be an exposure pathway of potential concern, although the limited opportunity for and likelihood of exposure suggests that unacceptable levels of risk (associated with ingestion of fish tissue containing mercury) would not be anticipated. This issue will be further addressed in Section 4.

3.4.2 *Ecological Evaluation*

A summary of the results of the Ecological Screening Evaluation is discussed below by medium. The significance of constituents exceeding BTAG screening levels was further addressed in Section 4 to determine whether remediation of the identified areas and constituents is warranted.

3.4.2.1 *Soils*

The results of the soil screening evaluation are discussed below by area.

Industrial Areas

Results of the screening analysis indicated that a number of constituents, including PAHs, pesticides (primarily dieldrin), and inorganics frequently exceeded screening levels. However, as described in Section 2.0, the Middletown Airfield NPL Site is almost entirely developed for industrial and urban uses, and there is very little undisturbed natural habitat. In addition, there are no federal or state threatened or endangered species and no critical environments in the vicinity of the Site. The data were collected from the Industrial, Lagoon, Runway and Terminal Areas and were largely collected from areas adjacent to and beneath asphalt. The presence of structures and pavement in the Industrial Areas limits potential exposures of ecological receptors to soil in this area. Furthermore, the Industrial Areas do not provide quality habitat for wildlife nesting and foraging. Any receptor use of the Site would be transient in nature. Therefore, because of the lack of natural habitat on-site and the absence of sensitive receptors, reported constituent exceedences in the Industrial Areas do not represent a potential threat to ecological receptors.

Penn State and Meade Heights Areas

Reported concentrations of inorganics in both the Penn State and the Meade Heights soil samples were representative of naturally occurring levels. Reported PAH concentrations in the Penn State Area were generally consistent with levels found in the Industrial Areas of the Site; other semivolatile constituents in Penn State soils were not present at levels of concern with respect to ecological receptors. No organic constituents were detected above BTAG levels in the Meade Heights Area. Thus, based on this comparison to screening criteria, no further evaluation of soils in the Penn State and Meade Heights areas is warranted.

3.4.2.2 Surface Water and Sediment

The results of the surface water and sediment screening are discussed below, by area.

Susquehanna River

Organic constituents detected in surface water appear to be anomalous and do not represent a potential threat to ecological receptors. Inorganic constituents are either within the range of reported background concentrations or they were infrequently detected and/ or infrequently exceeded screening levels.

Numerous organic and inorganic constituents were detected in sediment samples. With respect to the organic constituents, reported concentrations were generally within the range of reported upstream concentrations and several of these constituents were infrequently positively detected. Inorganic constituents exceeded screening levels at both upstream and downstream stations.

It should be emphasized that because of the multiple land uses and the numerous potential sources of contamination in the area, the distinction of ecological impacts to the river attributable to the Site are difficult to determine. Numerous records exist of pollution events in the Susquehanna River which may have contributed to the presence of chemical constituents in the river. These event include fuel oil spills, damage from sandblasted bridge paint and discharge of dye wastes. In 1985, transformer valves were damaged on the power plant adjacent to the eastern end of the Site causing electrical transformer oil with residual PCBs to be spilled into the Susquehanna River. In addition, it is highly probable that other accidents of this nature as well as other types of contaminant spills have occurred in the river over time (GF, 1990b).

According to the RI Report, healthy aquatic communities are present in the Susquehanna River with relatively diverse macroinvertebrate fauna and many harvestable fish species. The RI concluded that it did not appear likely that any site-related constituents could be posing a significant risk to the biota of the Susquehanna River.

Meade Heights

No constituents of concern were identified in surface water samples collected from the Meade Heights tributary based on the comparison to ecological screening levels. Similarly, organic constituents reported in Meade Heights sediment samples do not represent a potential threat to aquatic receptors. Naturally occurring inorganic constituents were detected in sediment samples.

Finally, it should be emphasized that the results of the Meade Heights Stream Survey conducted by ERM (see Appendix G) concluded that overall good water and sediment chemical quality was indicated by the assessment of the aquatic community.

4.0 RISK MANAGEMENT ANALYSIS

In this risk management analysis, the results of the baseline risk assessment (BRA) presented in Section 3 are integrated with information regarding site use and site activities, to derive appropriate remedial action objectives. Section 4 presents the risk management analysis for the Middletown Airfield NPL Site (the "Site"), and describes the remedial action objectives developed from this analysis.

4.1 RISK MANAGEMENT ANALYSIS: SOILS

The following sections present the risk management analysis for soils in the Industrial Areas (including the pipelines, the runways, and the lagoons), Meade Heights, the Penn State Area, and the Warehouse Area.

4.1.1 Industrial Areas

Soils in the Industrial Areas were evaluated with respect to potential human health exposures, the migration of soil constituents to ground water, and ecological impacts. The results of this analysis are presented in the following sections.

4.1.1.1 Human Health Evaluation

With regard to direct exposure to soils in the Industrial Areas, the BRA for the Middletown Airfield Site concluded the following.

- Cumulative risks for workers were estimated using the default risk based concentrations (RBCs) developed by USEPA Region III for an industrial scenario (USEPA, 1995a). From this conservative analysis, the potential carcinogenic risks associated with direct contact of soils in the Industrial Areas were acceptable under USEPA guidelines; that is, total risks were estimated to be within the range of 1×10^{-6} and 1×10^{-4} (i.e., a risk of 1×10^{-6} indicates that there is an upper bound probability of one in one million of an excess cancer occurring as a result of the defined conditions of exposure).
- The estimated noncarcinogenic risks were also acceptable under USEPA guidelines (i.e., the total hazard indices were less than one, USEPA's threshold level for determining the potential for

noncarcinogenic effects to occur as a result of the defined conditions of exposure).

- Cumulative risk estimates were derived using both ERM and Smith data collected in the Industrial Areas.
- The primary contributors to the estimated risks were the polycyclic aromatic hydrocarbons (PAHs) and inorganics. With regard to PAHs, these compounds are commonly found in asphalt, road and runway runoff, jet exhaust, and power plant emissions (Menzie et al., 1992; ATSDR, 1993d)[1]. Thus, these constituents are likely to be associated with normal operations (including past, current and on-going activities) at the airport.
- In addition, historic off-site sources such as emissions from Crawford Station (a nearby fossil fuel power plant that is no longer in operation) may also have contributed to observed concentrations of PAHS in soil (via the deposition of particulate emissions from the plant).
- The fact that PAHs were frequently detected in soil samples collected from throughout the Industrial Areas further supports the conclusion that these constituents are likely to be associated with normal, current and on-going operations at the Site and/or historic activities off-site.
- With regard to inorganics, it should be noted that these constituents were generally detected at levels which are consistent with naturally occurring or background levels in soils.

4.1.1.2 *Migration of Soil Constituents to Ground Water (Leaching)*

Reported soil concentrations in the Industrial Areas were also evaluated to assess the potential for soil constituents to leach to ground water. This analysis involved comparing the data to a set of conservative, default leaching screening levels proposed by USEPA, and included by USEPA Region III in their Risk-Based Concentration Table (USEPA, 1995a).

1 PAHs are formed when organic material is heated or burned; thus, PAHs are associated with numerous nonindustrial sources, such as wood burning stoves and fireplaces, auto exhaust, charcoal grills, etc. PAHs are also associated with natural sources such as volcanoes and lightening fires.

As described below, reported concentrations of volatile organic compounds (VOCs), PAHs, and inorganics exceeded the default leaching screening levels; however, the limited distribution and low frequency of many specific exceedences did not suggest that the soils represent a source of ground water contamination. The following specific points should also be noted.

- The primary constituent of concern in ground water is trichloroethylene (TCE). However, TCE was only detected at concentrations above the leaching screening level (0.20 µg/kg) in 13 of 200 soil samples collected by ERM in the Industrial Area. In locations where TCE was detected, it was generally found only at a single depth interval, suggesting that it is not migrating downward from a detectable source.

- Reported concentrations of TCE were all less than the TCE Act 2 screening level for the ground water protection pathway (2,000 µg/kg) developed by the Pennsylvania Department of Environmental Protection (PADEP). Although the PADEP Act 2 levels are not promulgated criteria, they provide additional information to suggest that reported TCE concentrations in soil in the Industrial Area do not represent the source of the TCE found in ground water.

- Other chlorinated solvents were also detected (e.g., 1,2-dichloroethene, vinyl chloride); however, like TCE, their occurrence was very limited, and did not suggest a the presence of a discrete source. 1,2-DCE was detected in 7 of 200 ERM samples; similarly, vinyl chloride was only positively detected in 2 of 200 ERM samples (i.e., sample IAP-SB-3 and duplicate sample SB-3A at a depth of 3 - 5 feet). In addition, it should be noted that review by data validation chemists of these laboratory samples indicated that the vinyl chloride results are suspect.

- A number of PAH compounds were also found in excess of USEPA's default leaching screening levels. However, as with TCE and the other volatile compounds, the occurrence of these constituents does not suggest that industrial soils are serving as a source of these constituents. In addition, extensive ground water monitoring data from the Site has not demonstrated these constituents to be present in ground water at levels above Maximum Contaminant Levels (MCLs) or USEPA Region III tap water RBCs.

- A number of inorganic constituents exceeded leaching screening levels, as well. Barium, chromium, and nickel were among the inorganics most frequently found above their respective screening levels. However, review of the ground water data for filtered samples indicated that the only heavy metal to exceed its screening criterion was nickel. Dissolved concentrations of nickel exceeded the MCL in two monitoring wells, RFW-04 and ERM-23D, both located on the south side of Building 142. Note that the dissolved phase concentrations of iron and manganese in ground water also exceeded their screening levels. These constituents have not been shown to be site-related, and their presence in ground water likely reflects regional or background conditions, based on their ubiquitous occurrence throughout the Site).

- The leaching screening levels for inorganics are very low, and in many cases (including barium, chromium, and nickel), the screening levels are less than the reported background levels.

4.1.1.3 Ecological Evaluation

The BRA also evaluated the potential for soils in the Industrial Areas to pose a threat to ecological receptors. Again, the analysis utilized a streamlined screening approach, in which reported constituent concentrations were compared to threshold concentrations developed by USEPA Region III (i.e., the Biological Technical Assistance Group or BTAG). Results of this comparison indicated that a number of constituents exceeded the ecological screening levels. However, these screening levels are very conservative, and their exceedence does not necessarily indicate a potential threat to ecological receptors. Furthermore, because of airport operations, the Industrial Areas offer only very limited habitat for ecological receptors, thus significantly reducing the potential for exposure. For this reason, exceedences of the BTAG levels by constituents in these areas do not indicate an unacceptable risk to environmental receptors.

As in the previous portions of the analysis, the primary constituents exceeding ecological screening levels included PAH compounds and the inorganics. The PAH compounds are likely to be associated with both historic and on-going conditions at the Site, in light of their association with various activities related to routine airport operations (i.e., road and runway runoff, jet exhaust). The inorganics are generally typical of background concentrations or naturally occurring levels in soils. Thus, based on the levels and types of constituents found, as well as the limited habitat present in the Industrial Areas, soils in the Industrial Areas do not appear to represent an unacceptable risk to ecological receptors.

4.1.2 *Meade Heights*

Organic constituents detected in direct push soil samples from the Meade Heights Area included acetone, bis(2-ethylhexyl) phthalate (DEHP), and methylene chloride. These constituents are common laboratory contaminants (USEPA, 1989; ATSDR, 1993c), and their presence at low levels renders the reported concentrations suspect. Organic constituents were evaluated with respect to residential and industrial RBCs, leaching screening levels, and ecological screening levels, with the following results.

- There were no exceedences of either industrial or residential RBCs. The cumulative carcinogenic risk was less than 1×10^{-6}, and the total hazard index was less than one, indicating that no unacceptable risks are anticipated to be associated with exposure to Meade Heights soils.
- There was a single exceedence of a leaching screening level; methylene chloride was reported at a concentration of 11 µg/kg at MH-GS-6 (8 - 10 feet), which is slightly above its leaching screening level of 10 µg/kg; as noted previously, methylene chloride is a common laboratory contaminant, and its presence is suspect.
- No BTAG screening levels are available for the reported constituents; however, the limited occurrence, together with the suspect nature of the reported organic constituents, suggests that their presence is not of concern.

Inorganic constituents found in Meade Heights soil samples appear to be generally consistent with background. Cadmium and vanadium concentrations exceed the site-specific background values, but are within the range of concentrations reported for US soils (Dragun, 1988; ATSDR, 1990). Review of the data further suggests that there is no defined hot spot nor is there a known source of these constituents; furthermore, these constituents have not been found to be site-related in previous investigations. In the absence of any defined sources and known historical activities involving these constituents, it is most likely that the inorganic constituents (including cadmium and vanadium) are all naturally occurring.

4.1.3 *Penn State Area*

PAHs were consistently detected in all three samples from the vicinity of a walk way that connects the housing area with the campus. Reported concentrations of the PAHs were generally similar to concentrations found in the Industrial Area. In addition, several pesticides, including DDT, dieldrin, endosulfan, endrin, lindane, and chlordane, were detected in the grassy area east of the walk way area. It is possible that the presence of at least some of these pesticides is associated with past lawn care activities or regional agricultural activities. These constituents are not known to be related to site activities. Reported inorganic concentrations in these samples were generally consistent with background levels.

Results of the screening indicated that there are no unacceptable levels of risk associated with direct contact of these soils. Similarly, comparison to the leaching screening levels showed only isolated exceedences of barium, cadmium, chromium, dieldrin, nickel and several PAH compounds. The limited occurrence of these exceedences does not indicate that Penn State soils are serving as a source of ground water contamination.

Comparison of the data from the Penn State Area with the ecological screening levels similarly identified some exceedences of BTAG levels, principally in the area of the walk way. Habitat in this area is expected to be somewhat limited as a result of the use of this area by Penn State students. In addition, future development plans may call for replacing the walkway with a road way. This would further limit potential habitat for ecological receptors. In light of the limited occurrence of elevated concentrations and the potential construction of a road way in this area, the data indicates that further evaluation is not warranted. This conclusion is further supported by the following:

- PAHs were detected ubiquitously across the Site, and
- The range of concentrations found in soil samples from the Penn State Area was similar to concentrations found in other parts of the Site.

4.1.4 *Warehouse Area*

Similar to the Industrial Area, soil samples collected in the warehouse area showed elevated concentrations of PAH compounds and some inorganics. However, evaluation of potential risks associated with exposure to these soils indicates that the levels of risk are acceptable under USEPA guidelines for human exposure.

Reported soil constituents in the Warehouse Area were also evaluated to assess the potential for soil constituents to leach to ground water. The primary constituents to exceed leaching screening levels were barium and several PAHs. However, review of ground water data indicated that these constituents are not present at levels of potential concern in ground water.

Thus, soils in the warehouse area do not appear to be acting as a source of ground water contamination.

Evaluation of soils in this area with regard to ecological impacts also showed that some constituents are present in excess of screening levels. However, the data do not indicate that further evaluation is necessary, for the following reasons.

- The majority of the area is paved, limiting the potential for direct exposure to soils by ecological receptors, and limiting the potential habitat afforded by the Warehouse Area; and
- The random distribution and limited frequency of exceedences also serves to limit the potential for exposure.

4.2 *RISK MANAGEMENT ANALYSIS: GROUND WATER*

The following sections summarize the risk management analysis for ground water in the Industrial Areas (including the Runway Area), the North Base Landfill (including the Sentinel Wells), and the residential wells sampled as part of the SSI.

4.2.1 *Industrial Areas*

The primary constituent of concern in ground water within the Industrial Areas is TCE. Out of 110 samples collected from Industrial Area wells, TCE was detected above the MCL (5 µg/l) in 70 samples. Concentrations in these wells ranged from 6 µg/l (in wells GF-218, GF-309A, and HIA-1) to 1,000 µg/l (well RFW-03, adjacent to well HIA-13). Other chlorinated volatile constituents were also detected above MCLs (1,2-dichlorobenzene, 1,2-dichloroethene, 1,4-dichlorobenzene, carbon tetrachloride, chlorobenzene, methylene chloride, PCE, and vinyl chloride) in wells in the Industrial Areas; however, they were typically detected at concentrations above the MCL in fewer than 5 percent of the samples. Other organic constituents detected included DEHP (detected above the MCL in only 4 locations), DDT (detected in only 1 well), and dieldrin (detected in 10 locations). Inorganic constituents were also detected; however, as noted previously, the only dissolved phase constituent to exceed its MCL was nickel (which exceeded its MCL in 2 locations).

As required by the 1986 Record of Decision (ROD) issued for the Middletown Airfield NPL Site, ground water from the Industrial Area (Operable Unit 1) is being extracted and treated prior to distribution by the HIA public water supply system. Further, a subsequent ROD, signed in 1990, requires the implementation of institutional controls, preventing uncontrolled use of or exposure to untreated ground water. Thus, under current and realistic future use conditions, there are no unacceptable risks associated with the use of untreated ground water in the Industrial Area.

Results of the Capture Zone analysis indicates that based on average annual pumping rates, all of the ground water within the Industrial Area is not captured. There is a component of flow toward the Susquehanna River (see Appendix K, Scenario 4 discussion), which includes an area at the southwestern corner of the PAANG compound where concentrations of TCE range from 1 µg/l to 59 µg/l. However, in light of the fact that institutional controls prohibit any ground water use in this area and in light of the on-going monitoring of the Susquehanna River (required by the 1990 ROD), no additional measures are indicated at this time in order to ensure protection of human health or the environment.

4.2.2 *North Base Landfill/Sentinel Wells*

The 1990 ROD also mandated institutional controls that prevent installation of wells downgradient of the North Base Landfill and require quarterly monitoring of sentinel wells installed along the northeastern perimeter of the North Base Landfill for a five year period. Review of data from the sentinel wells collected during the SSI indicated that only two organic constituents were detected at concentrations above MCLs: DEHP and carbon tetrachloride. Each of these constituents are discussed below.

DEHP was detected in 7 of the 9 sentinel wells; it was positively reported 17 out of 30 samples collected from these wells, at concentrations ranging from 2 µg/l to 54 µg/l. DEHP was detected at a similar range of concentrations in ground water samples collected during the RI (GF, 1990b); it was also detected in soil samples collected from the North Base Landfill during the RI (GF, 1990b). However, DEHP was not specifically identified as a constituent of concern in the RI or in the 1990 ROD, possibly because an MCL for DEHP was not promulgated until 1992, and did not become effective until 1994, after the 1990 ROD was issued. With regard to DEHP in the sentinel wells, the following points were also noted.

- The results of capture zone tests performed on MID-4 (a municipal production well) indicated that the North Base Landfill is within the capture zone of MID-4. However, DEHP was not detected in MID-4.

- The potential risk associated with the maximum reported concentration (54 μg/l) in sentinel well ERM-7I is 1×10^{-5}, based on a comparison to the tap water RBC of 4.8 μg/l. This estimated carcinogenic risk is within USEPA's range of acceptable risk (i.e., 1×10^{-6} to 1×10^{-4}). It is also important to note that the sentinel wells do not represent actual exposure points, and that DEHP has not been detected in MID-04 (a production well), or in residential wells RES-02 and RES-03 located east of the North Base Landfill. DEHP was found residential well RES-01 (also located east of the North Base Landfill) during one of two sampling events, at a concentration of 1 μg/l. This concentration is less than the DEHP tap water RBC of 4.8 μg/l, and equates to a potential risk of 2×10^{-7}, which is less than USEPA's benchmark of 1×10^{-6}.
- The reported concentrations of DEHP fluctuated over the course of three quarterly sampling events by as much as an order of magnitude in each of the seven sentinel wells where it was detected.
- On-going monitoring of the sentinel wells is required by the 1990 ROD.
- DEHP is considered by USEPA to be a "ubiquitous" laboratory contaminant (USEPA, 1989; ATSDR, 1993c), and its presence may be due, at least in part, to cross-contamination of the sample during collection or analysis.

Carbon tetrachloride was only detected in samples collected from sentinel well ERM-9S (i.e., the shallow well in the ERM-9 nest), at concentrations ranging from 6 to 8 μg/l; these concentrations are only slightly above the carbon tetrachloride MCL (5 μg/l). The fact that carbon tetrachloride was reported only in the shallow well of this nest suggests that the source of this constituent is nearby. The following points should also be noted.

- Carbon tetrachloride was not detected in any of the samples collected from the ERM-7 or ERM-8 sentinel well nests.
- ERM-9 is located off-site; Personal Communication (1994) with a nearby homeowner indicated that there may have been a fill area located approximately 200 feet north of ERM-9.
- On-going monitoring of the sentinel wells is required by the 1990 ROD.

4.2.3 *Residential Wells*

Ground water samples collected from the residential wells were screened against tap water RBCs developed by USEPA Region III, and cumulative risks were estimated based on this screening. The total carcinogenic risk estimated for each well was within the range of acceptable risk defined by USEPA (i.e., 1×10^{-6} to 1×10^{-4}). The total estimated carcinogenic risk was equal to or exceeded 1×10^{-6} for only three residential wells: RES-02, RES-06 and RES-08. Each of these cases is discussed below.

- In residential well RES-02, the carcinogenic risk is associated with a reported concentration of dieldrin equal to 0.008 µg/l. Dieldrin is a pesticide. Although its use has been banned since 1987, it is still present in the environment as a result of its chemical stability and persistence. In considering the reported result, the following points should be noted.
  - Using Region III's tap water RBC of 0.004 µg/l for dieldrin , the estimated carcinogenic risk associated with the reported concentration of this pesticide was estimated to be 2×10^{-6}; no other carcinogenic constituents were detected in this well.
  - The reported value of dieldrin in RES-02 is less than the health advisories issued for both adults and children (the longer term advisories are 23 µg/l and 0.5 µg/l, respectively).
  - Based on the results of both the SSI and previous investigations, and on the conclusion noted in the 1990 ROD (page 11), dieldrin is not considered to be a site-related contaminant.
- TCE was found in residential well RES-06 at a concentration of 2 µg/l, nominally in excess of the tap water RBC of 1.6 µg/l, but less than the TCE MCL of 5 µg/l. The carcinogenic risk associated with this concentration is 1×10^{-6}. In considering the significance of the reported level, it should also be noted that RES-06 is not in use and has been out of service since approximately 1981. This location is currently served by the Harrisburg International Airport water system (Personal Communication from Mr. J. Frank to Mr. W. Fox, May 8, 1996).
- Arsenic was found in residential well RES-08 at a concentration of 4.5 µg/l. Using Region III's tap water RBC developed for carcinogenic effects, this reported concentration corresponds to an estimated

carcinogenic risk of 1×10^{-4}, the upper bound of USEPA's range of acceptable risk. The following points were noted.

- The reported concentration of arsenic in RES-08 is less than both the MCL (50 µg/l) and the proposed Maximum Contaminant Level Goal (MCLG) for arsenic (also 50 µg/l). It should be noted that MCLGs are typically set equal to 0 for constituents that are potential carcinogens. However, the proposed MCLG for arsenic was set equal to 50 µg/l, because of its potential value as an essential nutrient, based on studies conducted by the National Academy of Sciences (Integrated Risk Information System, July 1995).
- Arsenic is a naturally occurring constituent in soil and ground water systems, and its presence in ground water does not appear to be related to Site activities. Dissolved phase concentrations of arsenic were reported in samples from throughout the Site, including widespread detections in wells in the Industrial Areas, in the sentinel wells adjacent to the North Base Landfill, and in two wells upgradient of residential well RES-08 (i.e., GF-250 and HIA-18).
- Region III's tap water RBC for arsenic based on noncarcinogenic effects is equal to 11 µg/l; the reported arsenic concentration in RES-08 is less than 11 µg/l.

Cumulative exposure to noncarcinogenic constituents was also evaluated for the residential wells. The total estimated hazard index exceeded one (USEPA's benchmark for evaluation of noncarcinogenic hazard) for only a single residence (RES-06). The total hazard index calculated for this well was equal to 7. Iron and manganese contributed the greatest portion to the hazard index; when these two constituents were excluded from the calculation, the resulting hazard index was 0.3, well below one. Both iron and manganese occur naturally in ground water systems, and their presence does not appear to be related to Site activities. Furthermore, this well was constructed with a cast iron casing which could contribute to the observed inorganic concentrations. In the absence of a known site-related source, it is likely that the presence of these constituents is related to natural conditions and/or to the cast iron casing in this well. It should also be noted that, as stated previously, this well is not currently in use, and this location is served by the HIA water system.

No tap water RBC exists for lead. Thus, evaluation of lead in residential wells was limited to a comparison to the federal action level for lead (15 µg/l) promulgated under the Safe Drinking Water Act. Only one sample collected from a residential well showed an exceedence of this action level; the reported concentration in residential well RES-03, located near the North Base Landfill, was 19.1 µg/l. It should be noted that this location is served by public water, and that this well is not used as a drinking water supply. It should also be noted that samples collected from residential wells RES-01 and RES-02 did not show concentrations of lead elevated above the action level. Since these two wells are located closer to the North Base Landfill than RES-03, it suggest that the source of lead in RES-03 is not related to the North Base Landfill.

4.3 *RISK MANAGEMENT ANALYSIS: SURFACE WATER/SEDIMENT*

The following sections outline the risk management analysis for surface water and sediment samples collected from the Susquehanna River (based on quarterly sampling data collected to date) and from Meade Heights (based on the data collected in the SSI).

4.3.1 *Susquehanna River*

The 1990 ROD stipulated the collection of quarterly monitoring data from the Susquehanna River for a period of 5 years. Review of the data collected to date indicated the following:

- Surface water sampling indicated the presence of several VOCs, including 2-butanone, chloroform, methylene chloride, and tetrachloroethene. Each compound was detected in only one sample (out of 7 rounds of sampling from 4 different locations) at concentrations less than 10 µg/l.
- Several pesticides were also detected in surface water samples, including alpha chlordane, gamma chlordane, DDD, and lindane (gamma BHC). As noted above, pesticides have not been identified as site-related constituents, either in previous studies or in the SSI. They appear to be present regionally, and their detection in both upstream and downstream samples supports this conclusion. These constituents were infrequently detected in both soil and ground water samples collected from the Site. This further suggests that their presence in the Susquehanna River water samples is not related either to past flooding of the Site, or to ground water discharging from the Site into the River.

- Inorganic constituents were detected in all surface water samples; however, these constituents are typically associated with natural surface water and sediment systems, and their presence does not necessarily indicate contamination.
- Sediment data collected from the Susquehanna River also indicated the presence of VOCs, pesticides, PAHs, PCBs, and inorganics in both the upstream and downstream samples. In general, the organic compounds were detected in similar concentrations in both upstream and downstream samples, indicating that their presence is due to regional rather than site-related conditions. However, inorganic constituents were detected in higher concentrations in some of the downstream sediment samples, indicating that they may be associated with runoff from the Site or from other commercial and industrial facilities located near the Site. This is discussed more below.

Analysis of these data in the baseline risk assessment indicated the following.

- Human exposure to surface water and sediment in the vicinity of the Site is limited by restricted access to the shore line in this area. Furthermore, the water is very shallow in the area immediately offshore from the Site. Thus, swimming, wading, water-skiing and other recreational activities are not expected to occur in this area. The only significant route of exposure would be through ingestion of fish caught in the portion of the Susquehanna River adjacent to the Site. This exposure pathway is applicable only for bioaccumulative constituents (e.g., pesticides, PCBs, mercury); these constitutes are discussed below.
  - Although pesticides and PCBs were occasionally detected in both surface water and sediment, their limited detection frequency indicates that this exposure pathway does not appear to be significant.
  - Mercury was detected in sediment samples from both upstream and downstream locations at levels that could pose a potentially unacceptable risk through the ingestion of bottom dwelling fish (e.g., catfish) in this area. However, it should be noted that fishing for catfish or other bottom dwellers is commonly done from the shoreline. Opportunities for shore fishing are limited at this site because access by the public is restricted. Thus, this exposure pathway is not believed to represent a significant risk.

- Neither pesticides, PCBs nor mercury have been found to be Site related constituents of concern, based on the results of previous studies and the SSI.

- It should also be noted that pesticides, PCBs, and heavy metals in sediment represents a potential concern for many surface water bodies throughout the U.S., and that data from the Susquehanna River Basin Commission suggests that persistent organics and heavy metals may be present in sediments throughout the Susquehanna River including the portion adjacent to the Site (Susquehanna River Basin Commission, 1991; referenced in Fact Sheet for the Susquehanna River from the Alliance for the Chesapeake Bay).

• Evaluation of potential exposure to reported constituents by ecological receptors indicated the following.

  - The only organic constituents in surface water to exceed ecological screening levels were alpha chlordane and gamma chlordane. These constituents were detected at only one station (SR-SW-05) during a single round of sampling (September 1995); their presence was not confirmed during the subsequent sampling event (November 1995). Chlordane was a commonly used termaticide until 1988. Like many pesticides, it is very persistent in the environment, with a half life in surface water of over 400 days (USEPA, 1986), making it even more resistant to environmental degradation than DDT (a well-recognized environmentally persistent pesticide). It should also be noted that both alpha and gamma chlordane were infrequently detected in Site soils (each isomer was reported only once out of 186 samples) or ground water (both isomers were detected once the sample from residential well RES-05; gamma chlordane was also detected in a single monitoring well; 110 ground water samples were collected in the SSI).

  - Eighteen semi-volatile constituents detected in sediment samples from the Susquehanna River exceeded ecological screening levels, including 14 PAH compounds. However, with the exception of two compounds (i.e., 4-methylphenol and DEHP), all of the reported downstream concentrations were within the range of upstream concentrations. With regard to 4-methylphenol and DEHP, these compounds were also detected in upstream samples, although at lower concentrations than in downstream samples. In addition, these compounds have not been identified previously as compounds of concern. It is also worth noting that 4-methylphenol has not been detected in any on-site monitoring wells, and DEHP has not been found above levels of concern in monitoring wells located along the Susquehanna River (i.e., reported levels are less than both the MCL of 6 µg/l and less than the Ambient Water Quality Criterion for chronic exposures of 360 µg/l). This indicates that these compounds are not present as a result of ground water discharge to the River.

- Several pesticide and PCB constituents also exceeded ecological screening levels for sediments. However, as noted above, these constituents have not been identified as site-related in previous investigations. Because these constituents were infrequently detected and reported exceedances were often not confirmed in prior or subsequent sampling events, these results suggest that impacts to the aquatic community would not be expected due to the presence of these constituents in sediment.

- Several inorganic constituents exceeded screening levels, including aluminum, chromium, copper, cyanide, iron, lead, mercury, silver, and zinc. However, reported concentrations were generally within the range of concentrations reported for the upstream or background location, although there were occasional elevated concentrations in downstream samples. It is important to note that, where screening levels and/or upstream concentrations were exceeded, the exceedences typically occurred in isolated sampling events, and were not reported routinely.

- Although the inorganic constituents were not identified as constituents of concern in soil, their presence in sediment may be associated with Site runoff, or their presence may reflect regional conditions. Runoff from other industrial and commercial areas surrounding the Site may also have contributed to the observed concentrations.

- Ongoing monitoring of surface water and sediment is required by the 1990 ROD. The results of this monitoring will be helpful in assessing the significance of the reported concentrations.

With regard to the ecological screening assessment, it is important to note that the screening levels used in this analysis are considered to be very conservative, and are generally based on the most stringent toxicity information found. Thus, exceedence of these levels does not necessarily indicate a threat to ecological receptors at this Site.

4.3.2 *Meade Heights Area*

Surface water and sediment sampling were collected during a single sampling event from Meade Heights as part of the SSI. Analysis of these data in the baseline risk assessment indicated the following.

- The only positively detected constituents in surface water samples were inorganics. Review of these data suggested that upstream and downstream concentrations were generally consistent for most constituents and these concentrations were likely to reflect natural variability.

- Potential human exposure to these constituents is expected to be limited to children who may occasionally play in the stream. Since inorganics are poorly absorbed across the skin (USEPA, 1992), no unacceptable levels of risk are expected to be associated with these constituents.

- Screening of the surface water data against Region III BTAG levels indicated that the only exceedence at a downstream location was for iron, at a single station. Iron occurs naturally in surface water systems, and its presence in surface water samples collected from Meade Heights is not believed to be related to Site activities.

- Several VOCs and PAHs, as well as inorganic constituents, were reported in both upstream and downstream sediment samples from Meade Heights. Concentrations were generally similar, although in some cases, downstream concentrations did exceed upstream concentrations. In light of the limited number of samples collected, it is not clear that these variations are significant. In considering the sampling from this area, it is important to recognize that the Meade Heights area receives runoff from the Pennsylvania Turnpike. Thus, concentrations of PAHs would be expected to be present, and are likely to be unrelated to Site activities.

- Potential human exposure to these sediments is expected to be limited to occasional dermal contact. The low levels of constituents reported in the stream, and the limited potential for these constituents to be absorbed through the skin indicates that these exposures do not represent a significant risk.

- Screening of the sediment data against Region III BTAG levels indicated that the only constituent to exceed a screening level was chromium, which exceeded the conservative BTAG level (0.005 mg/kg) in all samples, including the upstream location. Reported results from all locations were generally consistent for all locations (i.e., the range was 4.4 mg/kg to 7.4 mg/kg; the concentration in the upstream sample was 6.5 mg/kg). In light of the general consistency of reported results, and in light of the fact that chromium is not considered to be site-related, the reported concentrations of chromium in sediments are not considered to represent a concern. In addition, as noted in the BRA the chromium screening level is based on potential impacts to tobacco, and potential impacts to this plant do not represent a concern in the Meade Heights tributary.

4.4 *REMEDIAL ACTION OBJECTIVES*

Based on the results of the analysis presented above, the following risk management sections have been defined for the Site.

4.4.1 *Soils*

No actions are necessary to address soils at the Site.

4.4.2 *Ground Water*

Institutional restrictions on ground water use in the Industrial Area and in the area south of the North Base Landfill should be continued to limit potential use or direct exposure to ground water. In addition, it is expected that pumping and treatment of ground water from the Industrial Area will continue, to control the discharge of ground water to the Susquehanna River. If pumping of ground water in this area is discontinued, then monitoring of the Susquehanna River becomes more critical. Evaluation of the need for monitoring will be undertaken as part of a five year review required by the 1990 ROD.

4.4.3 *Surface Water/Sediment*

Ongoing monitoring of surface water and sediment in the Susquehanna River is required as part of the 1990 ROD. Based on the data collected to date, no other actions are indicated at this time. However, it should be noted that, if pumping of HIA-13 ceases, then on-site monitoring of surface water and sediment in the Susquehanna River becomes more critical, to ensure that site-related constituents are not being discharged via ground water at levels that would pose a potential threat to human health or the environment.

It should be emphasized that because of the multiple land uses and the numerous potential sources of contamination in the area, the distinction of impacts to the river attributable to the Middletown Airfield Site are difficult to determine. Numerous records exist of pollution events in the Susquehanna River which may have contributed to the presence of chemical constituents in the river. These events include fuel oil spills, damage from sandblasted bridge paint and discharge of dye wastes. In 1985, transformer valves were damaged on the power plant adjacent to the eastern end of the site causing electrical transformer oil with residual PCBs to be spilled into the Susquehanna River. In addition, it is highly probable that other accidents of this nature as well as other types of contaminant spills have occurred in the river over time (Gannett Fleming, 1990b).

According to the RI report, healthy aquatic communities are present in the Susquehanna River with relatively diverse macroinvertebrate fauna and many harvestable fish species. The RI concluded that it did not appear likely that any site-related constituents could be posing a significant risk to the biota of the Susquehanna River.

Finally, it should be emphasized that the results of the Meade Heights Stream Survey conducted by ERM (see Appendix G) concluded that overall good water and sediment chemical quality was indicated by the assessment of the aquatic community.

No actions are required to address surface water and sediment in Meade Heights.

5.0 *PRESENTATION OF "NO ACTION" ALTERNATIVE*

After evaluation of the data and information collected to date for the Site, it has been determined that no further remedial action is required at this time. This section presents the "No Action" alternative and the basis for supporting the decision. The discussion will focus on the determination that no further action is needed for the protection of human health and the environment.

5.1 *SCOPE AND ROLE OF THE REMEDIAL ACTION*

Two RODs have been issued previously for this Site. The first ROD was issued for the protection of the drinking water supply in the area in December 1987. This ROD outlined an interim remedy which focused on the HIA drinking water supply wells as an operable unit. The ROD remedy consisted of providing a potable water supply to those served by the HIA water system. A central air stripping tower and treatment plant was constructed for this purpose.

The stripping and treatment system proposed consisted of two packed air stripper towers, three forced air centrifugal blowers, a clearwell with 30-minute retention time, gas chlorination, a small laboratory, booster pumps and associated pipelines. An ion exchange unit was added later for the removal of hardness.

The system was evaluated in terms of it's ability to meet ARARs and it was determined that it would be in full compliance with all applicable ARARs during it's operation.

Other areas of the Site were to undergo additional investigation as discussed in the 1987 ROD, since there was insufficient information to perform a complete analysis of potential concerns. In 1988 a remedial investigation (RI) and feasibility study (FS) were conducted for the remainder of the Site. Based on the results of the RI, five major study areas, operable units (OU), have been designated for the site.

- OU-1 Industrial Area - HIA Ground Water Production Wells
- OU-2 Industrial Area - Soils
- OU-3 Fire Training Area - Soils

remedial action has been taken into account in the selection of the "No Action" decision. This No Action alternative is presented as a final remedy selection for the Site.

Additionaly, during the course of the SSI, sediments in storm sewer vaults were sampled to determine of there may be an on-going source of contamination leaching to ground water or being discharged to the Susquehanna River. Elevated lead levels were detected in Vault J-5 of the storm sewer system (approximately 100 feet west of the southwestern corner of Building 208) during the SSI. The USACE is currently seeking a contractor to clean Vault J-5 to remove the elevated lead concentrations. The remainder of the storm sewer system will be addressed during the on-going storm sewer discharge permitting process.

5.3 *COMMUNITY PARTICIPATION*

The results of this FS will be used to prepare a Proposed Plan that will outline the selection of a final remedy for the site. The Proposed Plan will be issued as part of the public participation responsibilities under Section 117(1) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), commonly referred to as "Superfund", as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) and, to the extent possible, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP, 40 CFR 300).

The public is encouraged to become involved in the selection of the remedy by participating in the public meeting and public comment period. For more background on the site and environmental activities previously and currently being conducted, the pubic is invited to review this and other documents in the Administrative Record. The Administrative Record, which contains all information that will be used to select the response action, is available for public review at the following locations:

Middletown Public Library
20 North Catherine Street
Middletown, PA 17057

and

Administrative Record Coordinator
U.S. Environmental Protection Agency, Region III

- OU-4 North Base Landfill ...a - Ground Water
- OU-5 Meade Heights Area - Surface Water

An FS was then conducted to evaluate a range of remedial alternatives that would be protective of human health and the environment at the Site.

The second ROD was issued for the Site in 1990. In this ROD, the USEPA's strategy for protecting human health and the environment was to:

- reduce the mobility and volume of organic and inorganic contamination in the ground water as necessary;
- continue to prevent the ingestion of ground water containing contaminants in excess of regulatory drinking water standards or health-based levels;
- prevent human exposure to contaminated soil and dust during construction activities; and
- prevent aquatic organisms living in a stream or river environment from being adversely impacted by contaminants.

At the time of issue, this second ROD was intended to be a final remedy selection for the Site that would mitigate any imminent or substantial endangerment to human health and the environment for the first four operable units.

This ROD addressed OUs 1, 2, 3, [illegible] an interim action at OU-5, since the field investigation results were inconclusive in determining a source of contaminants and their potential environmental impact.

Under this ROD, the remedy selection for OU-1 was the continued operation of the ground water treatment system currently in place at the Site, the institution of ground water use restrictions, and the addition of monitoring for the water supply wells.

The remedy for OU-2 and OU-3 included land use and access restrictions; and the development of public and worker health and safety requirements for activities involving construction, demolition, and excavation or other activities that would disturb the Site soil.

The remedy for OU-4 which provides protection of well MID 04 from contaminants found in the North Base Landfill was to include it with the remedy for OU-1 to efficiently and effectively address ground water contamination at the Site.

The interim action required for OU-5 included the evaluation of water quality and organisms living in the stream near Meade Heights.

The selected remedy was determined to satisfy the remedy selection process requirements for CERCLA and the NCP for the first four operable units. The remedy selected provides protection of human health and the environment, achieves compliance with ARARs, and is cost effective.

It is believed that all investigatory actions required by the USEPA and PADEP have been met and subsequently a final remedy can be selected. The remedy selected as part of this FFS/Proposed Plan/ROD process will be the final remedy for the Site.

5.2 *DISCUSSION OF THE "NO ACTION" PREFERRED ALTERNATIVE*

Under CERCLA, USEPA can determine that the need to undertake a remedial action to ensure adequate protection of human health and the environment under Section 104 or 106 is not necessary and need not be invoked. Under such circumstances, the statutory cleanup standards of CERCLA Section 121 (e.g., compliance with Applicable, or Relevant and Appropriate Requirements [ARARs], cost-effectiveness) are not triggered and need not be addressed in documenting the determination that a "No Action" decision is appropriate for the site.

While "No Action" decisions may authorize monitoring to verify that no unacceptable exposures occur, such response decisions should not include any additional measures to eliminate, reduce, or control threats beyond the mitigation measures previously implemented. Therefore, a remedy including any treatment controls, engineering controls, or institutional controls would not be considered a "No Action" remedy.

The SSI discussed in this report was required by the USEPA's 1990 ROD, as clarified by the April 1992 Explanation of Significant Differences (ESD). After reviewing the ROD, the Pennsylvania Department of Environmental Protection (PADEP) asserted that the ROD did not fully investigate the relationship between soil and ground water contamination, nor did it consider active soil cleanup technologies. The USEPA incorporated the PADEP concerns into an ESD document. The ESD explained that the ground water remedy selected in the ROD was an interim action and that the final decision would follow in the ROD issued after the SSI was complete. The ESD further clarified that the requirement in the 1990 ROD that the existing water supply system must continue to operate even if airport operations ceases was eliminated and would be re-evaluated at a later date. The intent of the SSI was to satisfy the requirements of the ESD and the 1990 ROD.

A BRA was completed and the results generated were integrated with information regarding Site use and Site activities in order to derive appropriate remedial action objectives. The BRA focused on three distinct areas of concern; soil, ground water, and surface water/sediment. Each of these areas were further divided for analysis purposes.

The soils of the Industrial Area, Meade Heights, the Penn State Area, and the Warehouse Area were evaluated individually. Cumulative risks for workers and residential exposures were estimated using the default risk based concentrations (RBCs) developed by USEPA Region III. In addition, the BRA also evaluated the potential for soils to pose a threat to ecological receptors. Based on the results of the BRA and current and anticipated future site use scenarios, no actions are necessary to address soils at the site.

Ground water in the Industrial Area, the North Base Landfill Area, and residential wells was evaluated in the BRA. The primary constituent of concern in ground water in the Industrial Area is TCE. However, as previously discussed, remedial efforts are currently in place at the Site to manage TCE contamination in ground water in the Industrial Area. Ground water in other areas were found to contain low levels of a few contaminants; however, none were determined to be a concern or a potential future threat because of a lack of exposure potential.

Surface water and sediment samples were collected from the Susquehanna River and from the Meade Heights stream. Human exposure to the contaminants detected in the surface water and sediments in the Susquehanna River was shown to be limited because of the restricted access to the shoreline. In the Meade Heights Area, the only contaminants detected of concern were inorganic constituents. A comparison of upgradient and downgradient samples indicated that the concentrations detected were likely naturally occurring. This coupled with the facts that the most likely exposure to the constituents would be from children playing in the stream, and that the inorganic constituents are poorly absorbed across the skin; shows that no unacceptable risk are expected to be associated with these constituents. Ecological receptors are not expected to be impacted by the constituents found in the surface water or sediments.

Subsequently, the remedial action objectives reached based on the BRA are presented below.

- No action is necessary to address soils at the Site.
- Institutional restrictions on ground water use should be (and are being) continued in the Industrial Area and south of the North Base Landfill.
- It is expected that pumping and treating ground water in the Industrial Area will continue to control the discharge of ground water to the Susquehanna River as required in the 1990 ROD.
- On-going monitoring of surface water and sediment in the Susquehanna River is required as part of the 1990 ROD. No other actions are deemed necessary at this time.
- On-going monitoring of the sentinel wells at the Site is required as part of the 1990 ROD. No other actions are deemed necessary at this time.
- No action is required for surface water or sediment in Meade Heights.
- In the event that the HIA should cease the pumping of the production wells, there shall be a five year sampling and review period to assess whether any impact is being felt in the Susquehanna River.
- In the event any additional new or existing wells are to become operational in the HIA Industrial Area, the extracted ground water should be tested initially and monitored at least annually to document that no impact is being felt from the migration of contamination under the new pumping scenario at the Site.

Based on the results of the BRA, conducted as part of this SSI, it is concluded that the conditions at the site pose no current or potential threat to human health or the environment and no further remedial action need be implemented. Consequently, the site qualifies for a "No Action" decision.

The No Action alternative takes into account past remedial actions as discussed above and the results of the SSI. The selection of no further action for the Site is based upon the fact that there is currently a ground water treatment system in place that is effectively managing the risk associated with ground water contamination. The ongoing nature of that

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USEPA solicits input from the community on the cleanup methods proposed for each Superfund response action proposed. A public comment period will be announced after printing of the Proposed Plan. The community is encouraged to participate in the selection process. A public meeting will also be held at which time USEPA, along with the PADEP and DoD representatives will present the Proposed Plan, answer questions, and accept oral and written comments. Comments will be summarized and responses provided in the Responsive Summary section of the ROD.

5.4 *STATE ACCEPTANCE*

The state regulatory agency (PADEP) shall evaluate and assess the results of the SSI and the elements of the FFS. Any technical and administrative issues raised by the PADEP during it's review of the FFS and Proposed Plan shall be addressed in the final ROD for the Site.

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